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JUNE, 1955. **Vol. L, No. 6**

FIFTIETH YEAR OF PUBLICATION

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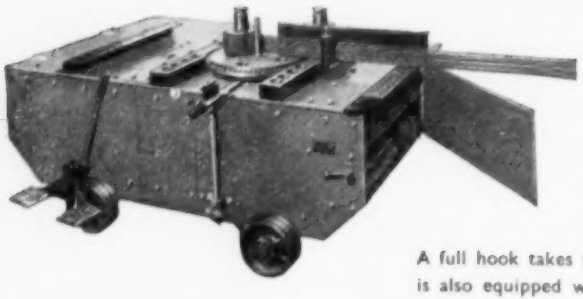
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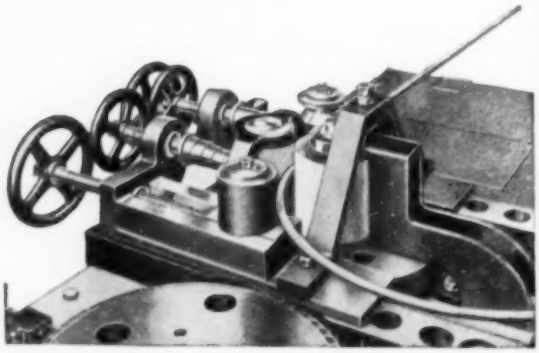


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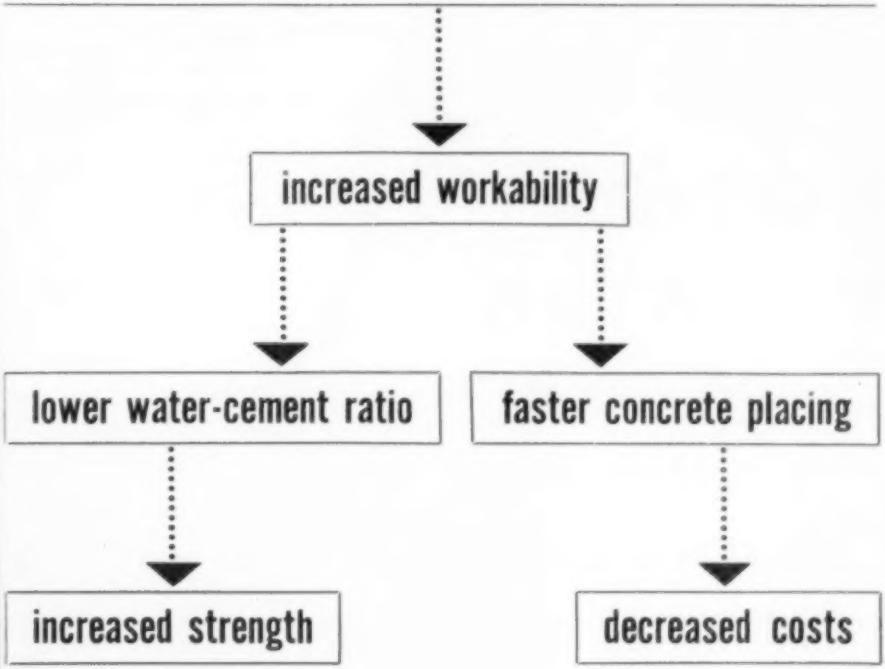
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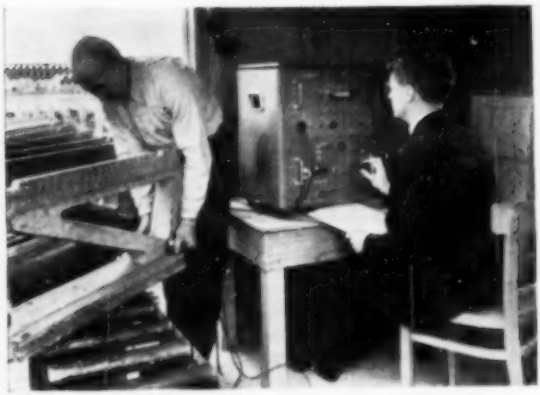
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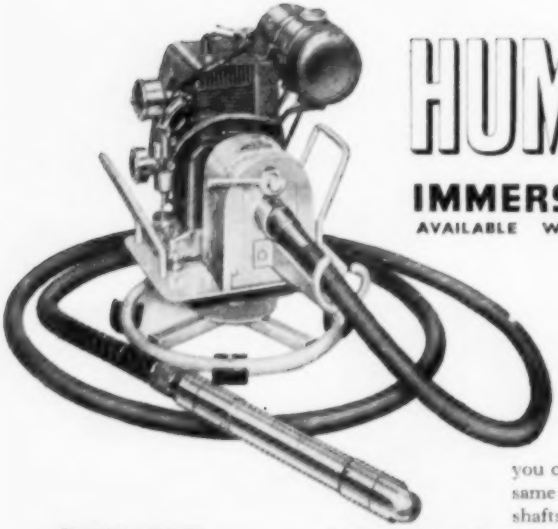
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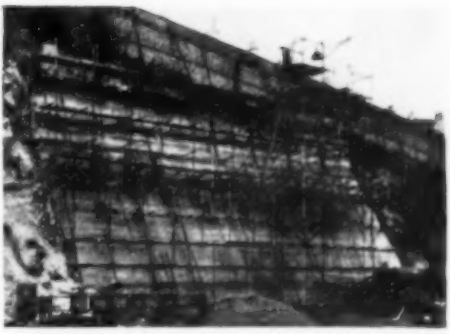
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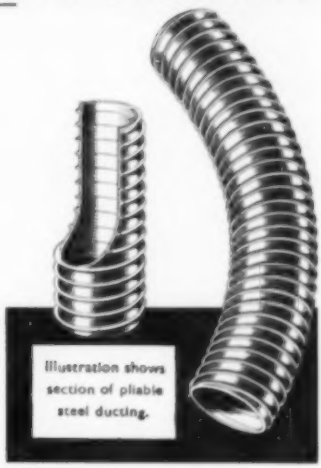


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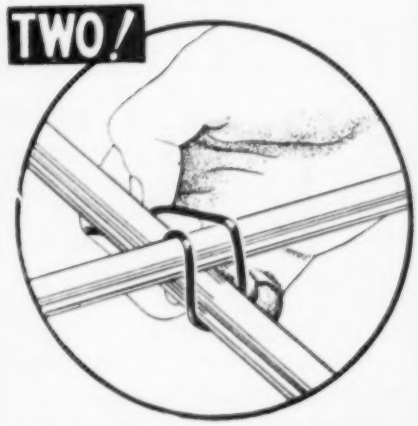
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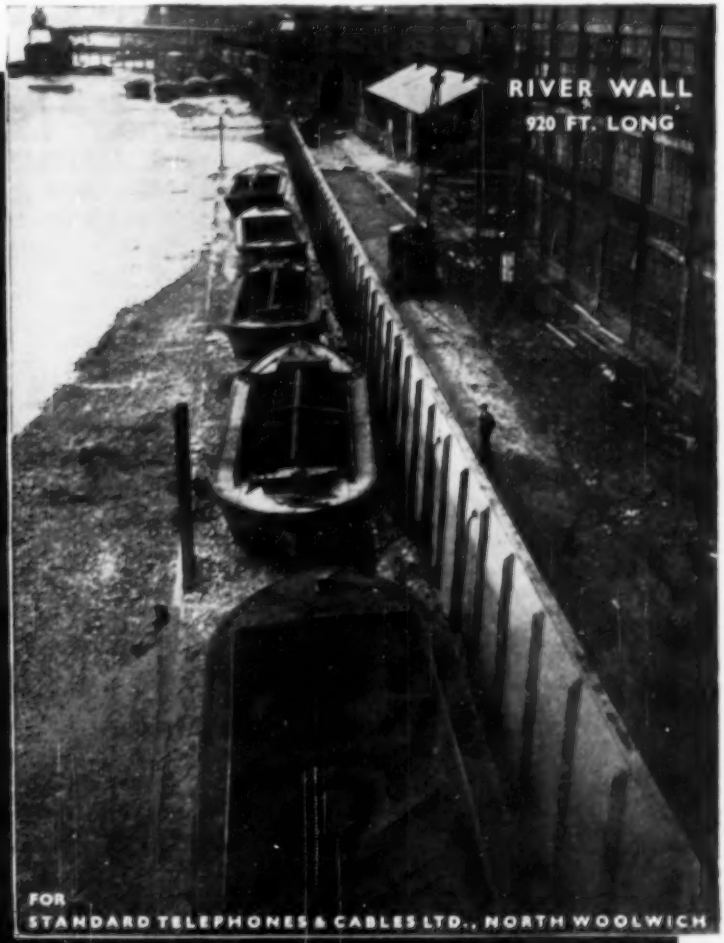
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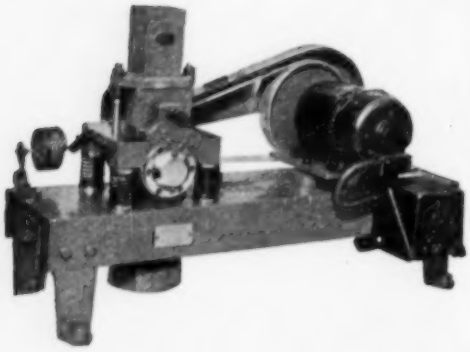


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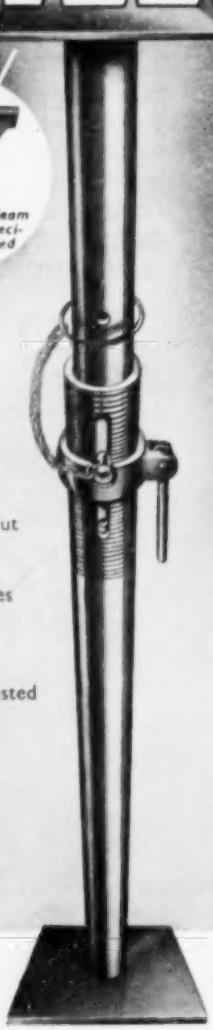
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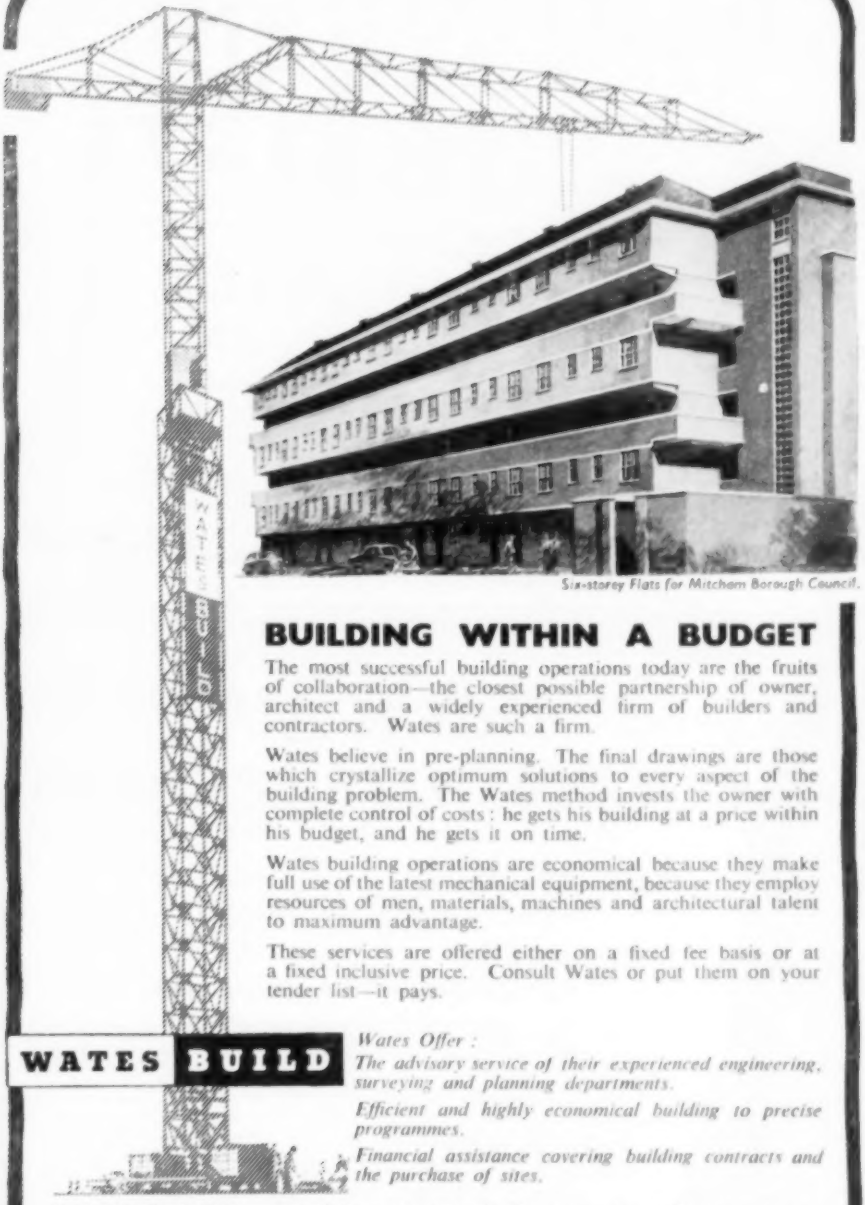
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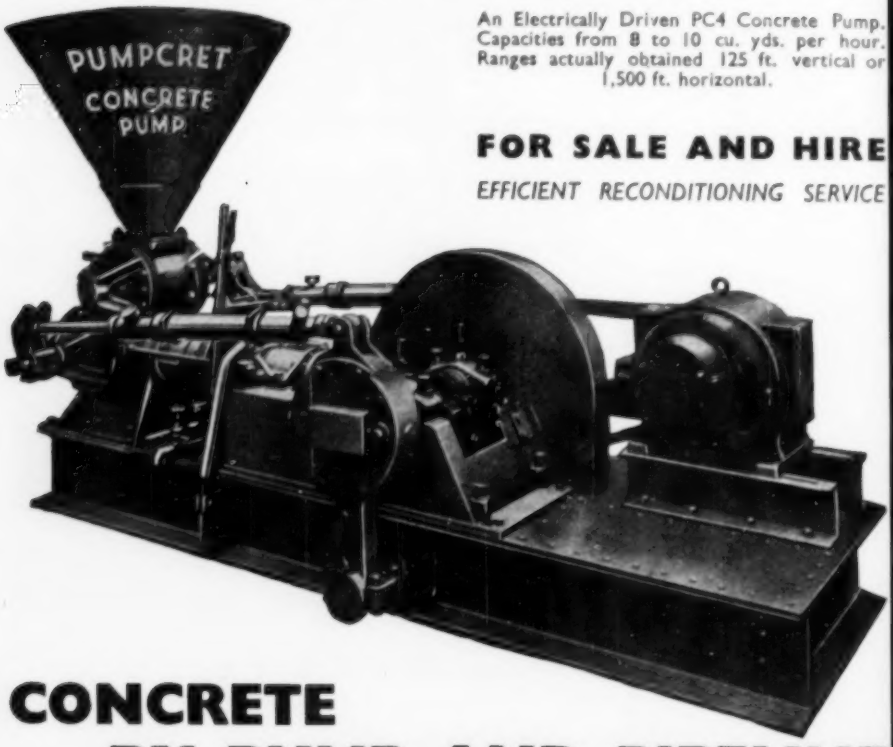
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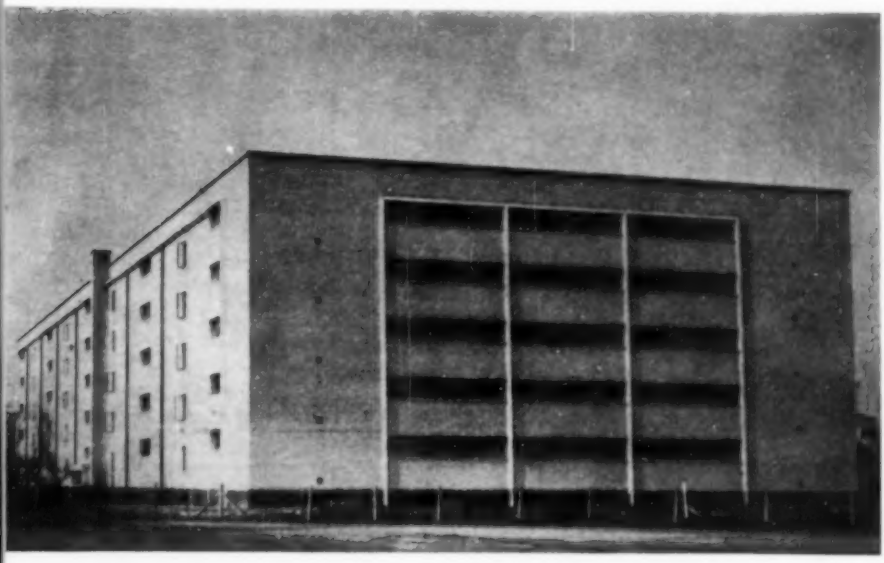
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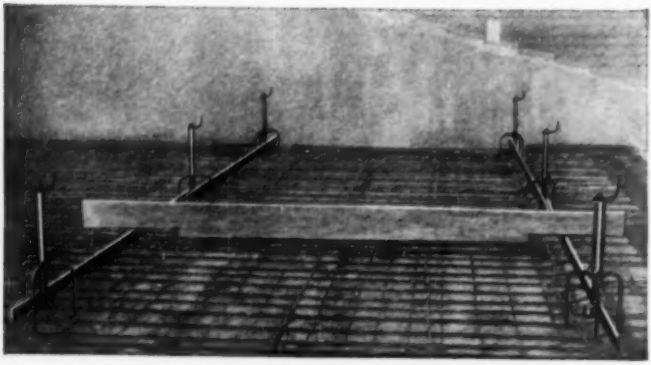
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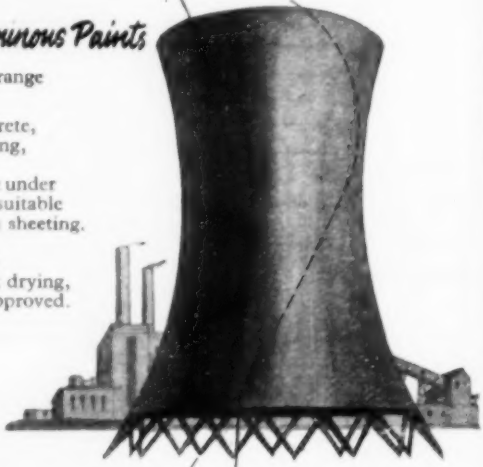
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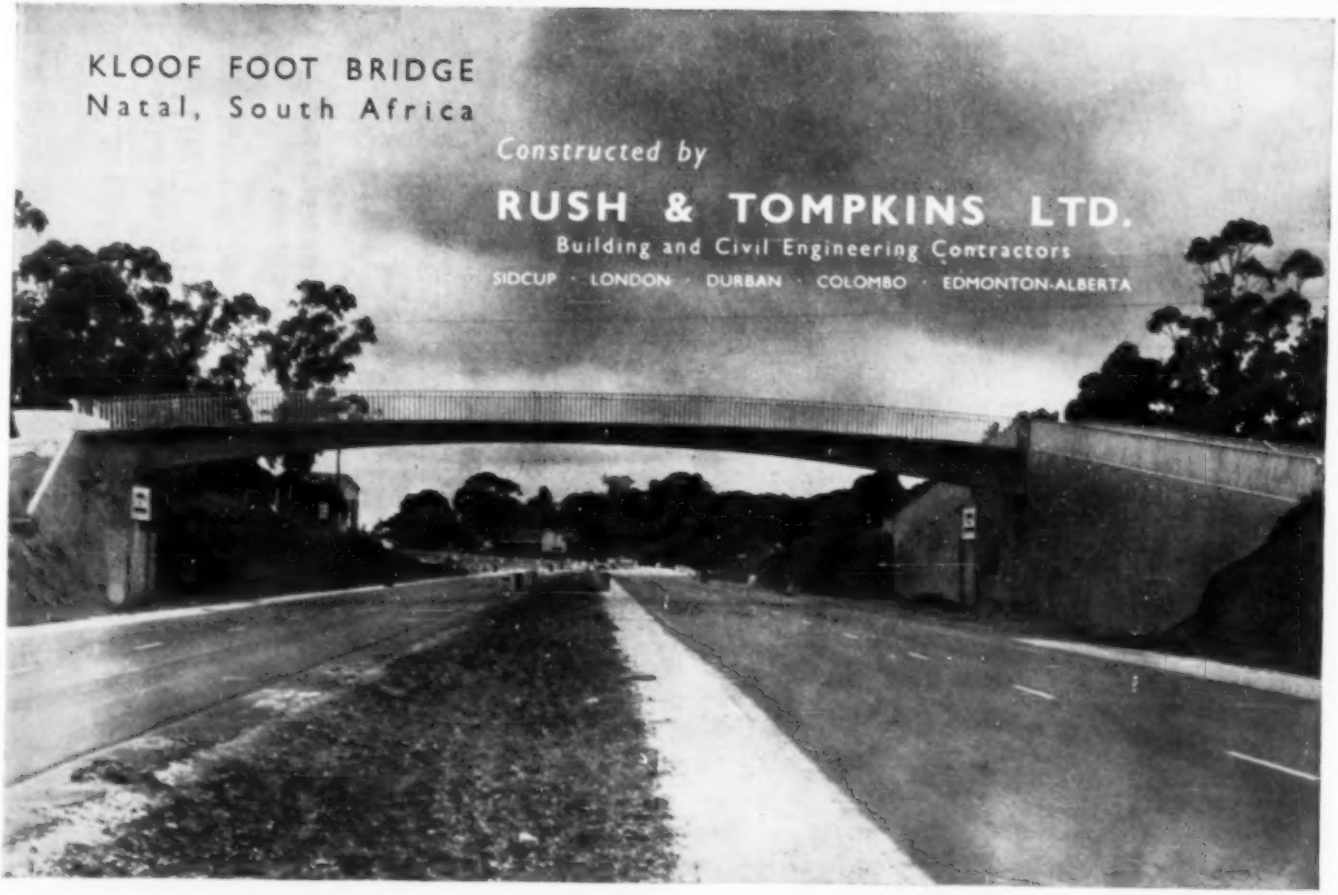
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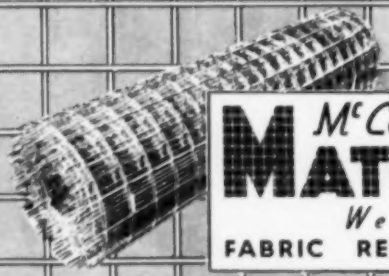
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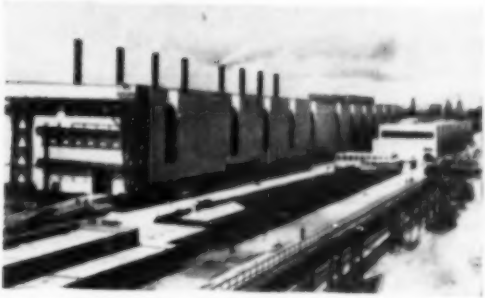
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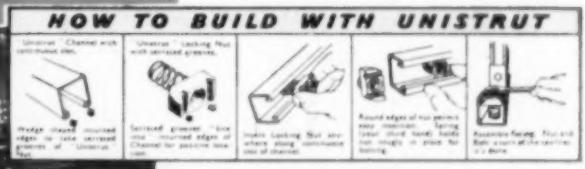
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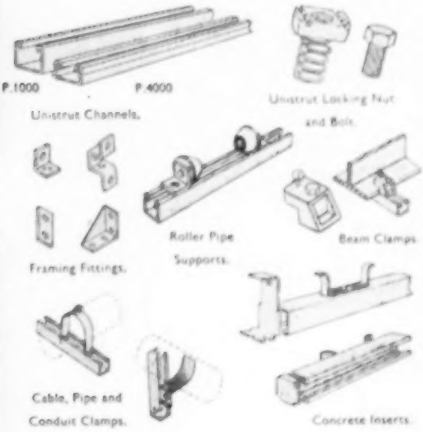
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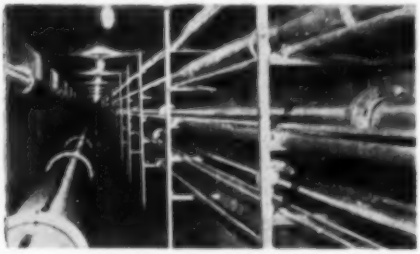
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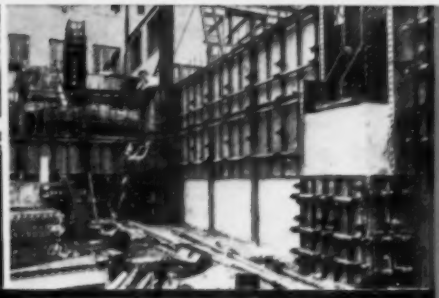
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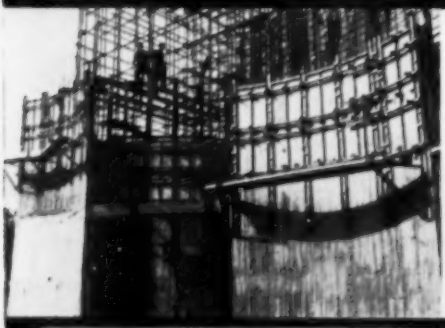
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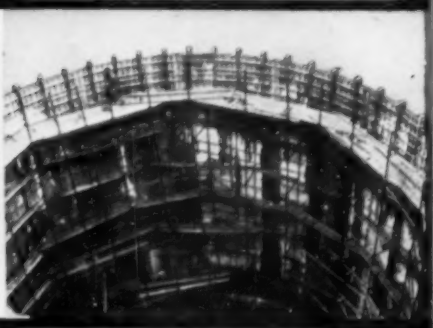
As formwork for 12in. thick foundation walls :
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Contractors : Messrs. F. J. Lovell & Son Ltd.



On retaining wall construction
at office extensions, Paddington, London.
Note how column projections are easily dealt with.



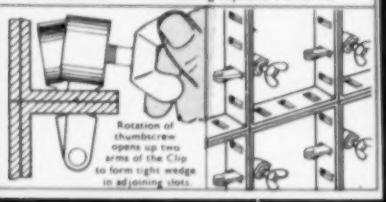
As formwork for cement storage silos :
Golden Bay Cement Company, New Zealand
Contractors : Messrs. Downer & Co. Ltd., New Zealand.



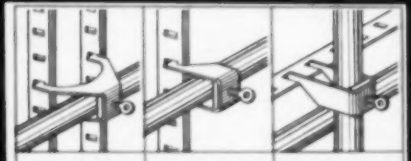
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Note also Acrow Scaffold Units employed as staging.
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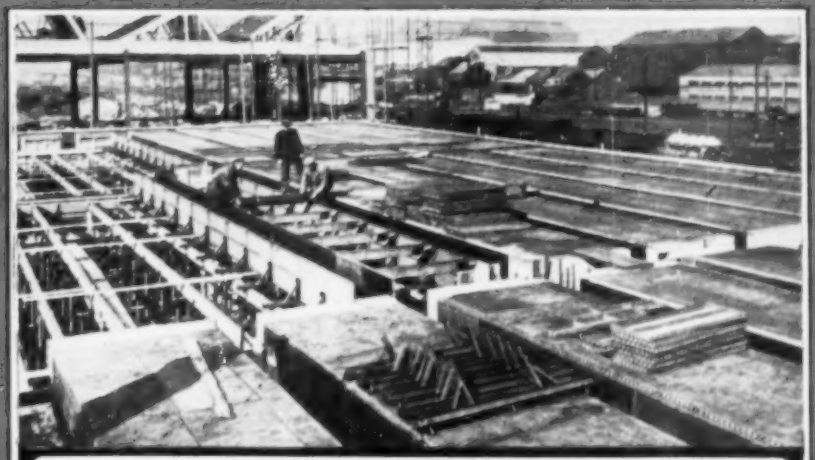
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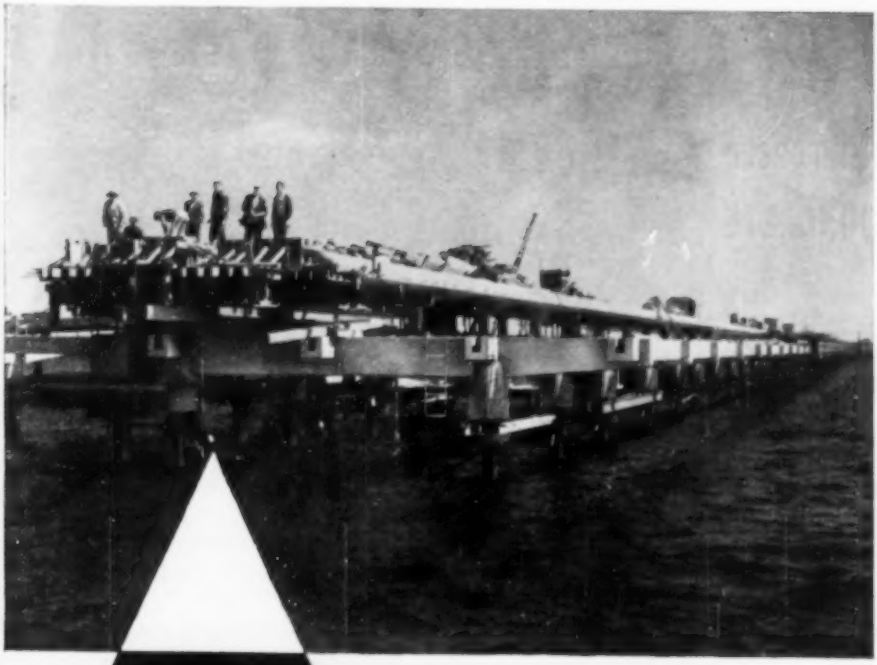
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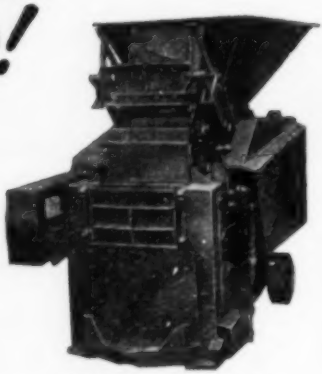
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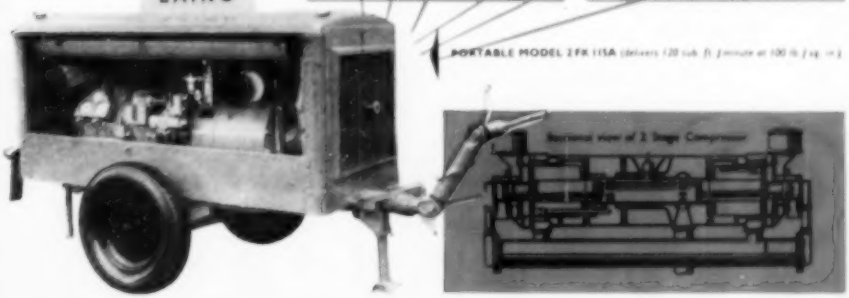
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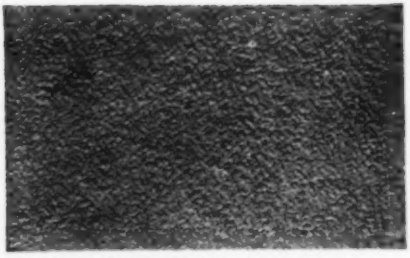
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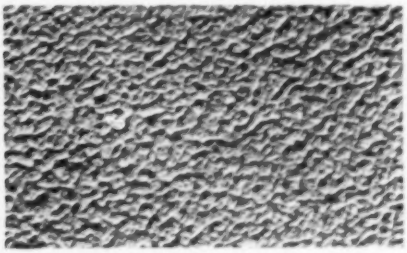
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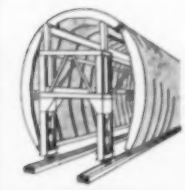
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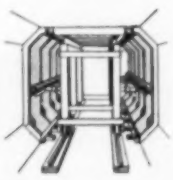
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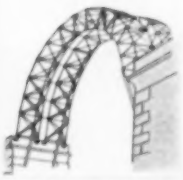
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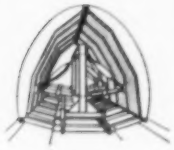

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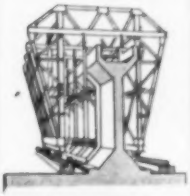

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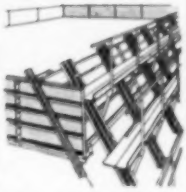

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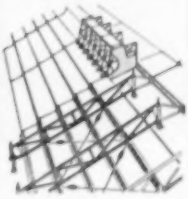

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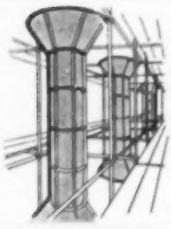

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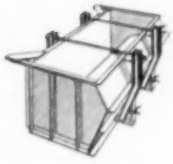

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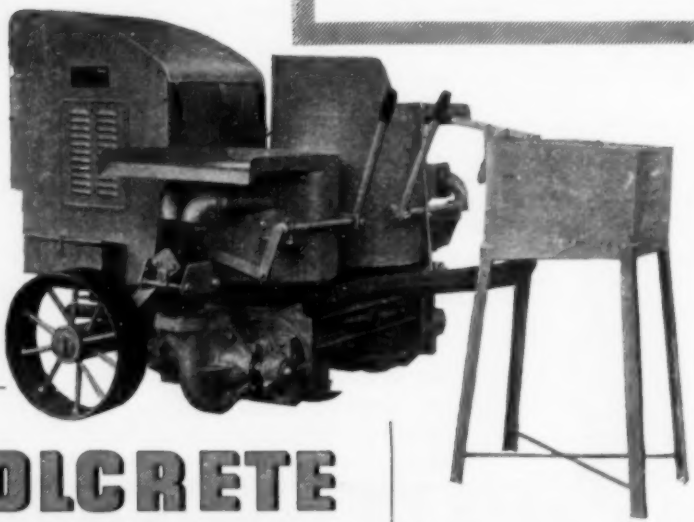
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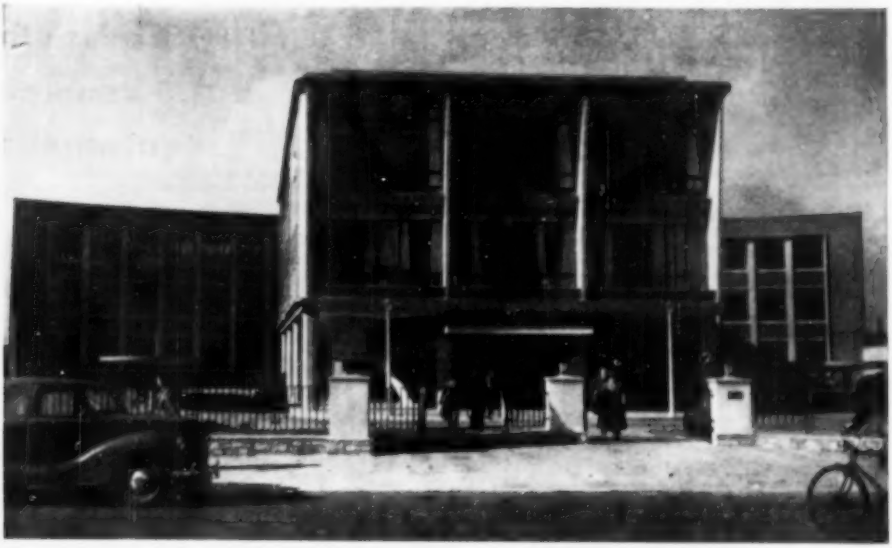
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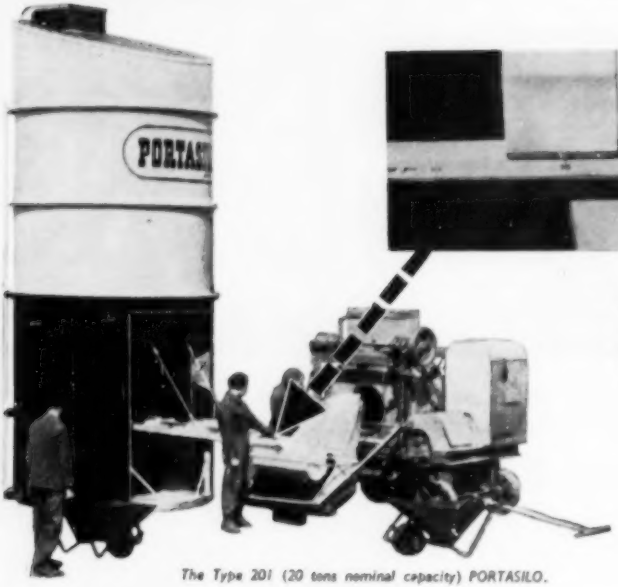
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Volume L, No. 6. LONDON, JUNE, 1955.

EDITORIAL NOTES

Proportioning Concrete Mixtures.

A METHOD of proportioning concrete developed by the Australian Department of Works and described by a correspondent on page 221 of this number appears to be a simple one, and to give the results claimed for it, but it may be suggested that some care is required in its use. Briefly, the method is to make a paste with given quantities of cement and water, gradually to add the sand to the paste until a pat one inch high will bulge but not flow when the sides are pushed to a vertical face, and which will be self-healing when cuts are made in the top with a trowel. It is claimed that the greater the volume of sand that can be added to the paste to produce a sample with these characteristics, the more economical is the sand. The required volume of coarse aggregate is the amount that can be added to a mortar satisfying the foregoing requirements, and which will produce the required workability.

This method of testing sand takes account automatically of the grading, surface area, and absorption of the material, the surface area being a function of the grading and of the shape of the particles. The finer the sand the greater is the surface area of a given volume with the consequence that more water is required to wet the surfaces of the particles and, therefore, the less the quantity of sand required to stiffen a paste made with given quantities of cement and water; in other words the higher the cement content of the mortar so long as the water-cement ratio is not increased. Again, the more absorbent the sand the more water it will absorb, and consequently less of an absorbent sand will be required to stiffen the paste than would be the case with a more impermeable sand. If the water absorption of the sand be left out of consideration, the quantity of sand that will be required to stiffen the paste depends on the surface area of the sand. As far back as the year 1918 a paper was published in the United States of America on "Proportioning of Materials of Mortars and Concretes by Surface Areas of Aggregates"[1], and more recently it has been shown[2] that specific surface area (that is surface area per unit weight) could be used as a method of classifying sands and could also be applied in the design of concrete mixtures. In both of these methods, however, estimates or measurements of the surface area of the sand have to be available. The method in use by the Australian

[1] Proceedings of the American Society for Testing Materials, Vol. 18, 1918, pages 235 et seq.
[2] A Classification of Natural Sands and its Use in Concrete Mix Design. A. J. Newman and D. C. Teychenne. Symposium on Mix Design and Quality Control of Concrete. London, May, 1954.

Department of Works dispenses with the need to measure the surface area and shows, so far as the mortar test is concerned, whether the combined surface area and absorption of the sand tested are less than those of a sand that will produce the consistency described in a mortar made with 4 lb. of sand, 1 lb. of cement, and 1¼ lb. of water.

The method of adding coarse aggregate to a selected mortar has also been used before. As described by our correspondent, the method seems to be an automatic way of maintaining a constant surface area of combined aggregate in that a small weight of sand of relatively high specific surface area is replaced by a much greater weight of stone of relatively low specific surface area. Methods of proportioning concrete based on the surface area of aggregates have been found to be satisfactory, but the measurement of surface area is not easy. The Australian method avoids this difficulty and should be satisfactory, even though the man making the test might not know that he was mechanically allowing for the effect of the surface area of the material. However, whether the proportions are based on type grading or on surface area, a trial mixture must be made if only as a confirmatory test. In fact, trial mixtures can be used successfully without sieve analyses, but the number of trials can be greatly reduced by comparing the results of sieve analyses with type gradings or if the surface areas of the aggregates are known. Even in cases where the gradings of the aggregate are such that no combination of them will approximate to a type grading, an engineer experienced in the effects of departures from type gradings can make a reasonable estimate of the proportions that will produce a satisfactory concrete, and no more than one or two trial mixtures may be necessary. The Australian method gives a systematic empirical approach to the trial mixture, and should yield satisfactory results even when used by testers with no knowledge of the underlying theory.

It must, however, be remembered that, when working with extremely fine or extremely coarse sands, the strength and workability of the concrete as determined by laboratory tests are not the only factors to be considered. The concrete as placed on the site may be different from that used in the tests, and dangers of segregation, honeycombing, and sand "runs" must be avoided or guarded against. Hence, it cannot altogether be agreed that strength is the over-riding factor, and that, in the words of our correspondent, the sand and stone are merely "cheap inert distenders" of a more expensive cement paste; this is an over-simplification of the problem. It is of course possible in the laboratory to make strong concrete with aggregates having extreme gradings, but it may not be possible on the site to secure the necessary care in placing and compacting to make the use of such concrete safe if high-grade concrete is required. Nor can it be agreed that the test would be sufficient in itself for the purpose of a specification or for the control of concrete making on the site. For example, it gives no information about the grading, for the same total surface area can be obtained with a wide range of gradings. It is necessary to avoid certain kinds of gradings, such as an excess of one size or the absence of a critical size, and, if such badly-graded sands must be used because of the high cost of more suitable sands it is at least necessary to warn the user against the risks that attend their use. Consequently it is hardly possible, and certainly not wise, to dispense with sieve analyses and limitations of gradings in a specification for fine aggregate.

The Effect of the Wind on Open Frames.

By D. DENNINGTON, B.Sc., A.C.G.I., A.M.I.C.E.

METHODS of accurately determining the forces due to horizontal wind action on open frames are, in general, too complex to be used for quick and acceptable results. The most frequently used method, namely, assuming points of contraflexure at the mid-point of the column, is easy to apply but requires an assumption of the distribution of the total horizontal shearing force between the columns at

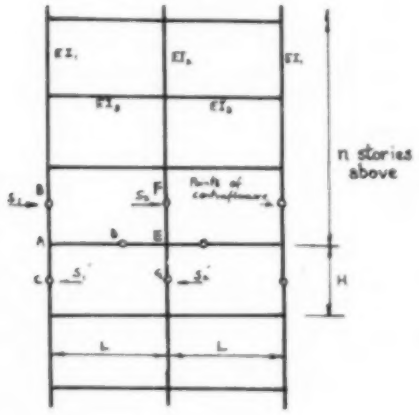


Fig. 1.

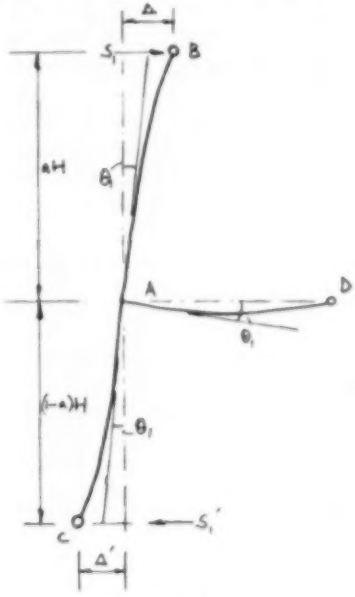


Fig. 2.

each level; the method described shows how the distribution may be calculated from the sizes of the members of the frame.

It is assumed that (*a*) the shearing forces on the frame are concentrated at the points of contraflexure of the columns and (*b*) the positions of the points of contraflexure of the columns are proportionally the same in two adjacent stories.

Consider a symmetrical frame with three columns (*Fig.* 1). The portion bounded by the points of contraflexure B, C, D may be isolated as shown in *Fig.* 2. Equating the angles of the columns,

$$\theta_1 = \frac{\Delta}{aH} - \frac{S_1 a^2 H^2}{3EI_1} \quad . \quad . \quad (1). \qquad \theta_1 = \frac{\Delta'}{(1-a)H} - \frac{S_1'(1-a)^2 H^2}{3EI_1} \quad . \quad (2)$$

where the symbols have the meaning shown in the figures.

Similarly considering the rotation of point E on the central column,

$$\theta_2 = \frac{\Delta}{aH} - \frac{S_2 a^2 H^2}{3EI_2} \quad . \quad . \quad (3). \qquad \theta_2 = \frac{\Delta'}{(1-a)H} - \frac{S_2'(1-a)^2 H^2}{3EI_2} \quad . \quad (4)$$

TABLE 1.

n	a	$\frac{1}{4a(1-a)}$	$\frac{a^2}{(1-a)}$	$\frac{a}{(1-a)}$
1	–	–	–	–
2	0·666	1·017	0·729	1·293
3	0·543	1·007	0·642	1·188
4	0·532	1·004	0·604	1·139
5	0·525	1·002	0·580	1·105
6	0·521	1·002	0·566	1·087
7	0·518	1·001	0·556	1·074
8	0·516	1·001	0·548	1·064
9	0·514	1·001	0·543	1·057
10	0·513	1·001	0·541	1·054
11	0·511	1·000	0·535	1·046
12	0·510	1·000	0·533	1·043

TABLE 2.

n	$\frac{n}{(2n-1)}$	$\frac{2n}{(2n-1)}$
1	–	–
2	0·667	1·333
3	0·600	1·200
4	0·572	1·143
5	0·555	1·111
6	0·545	1·090
7	0·539	1·077
8	0·533	1·067
9	0·530	1·059
10	0·527	1·053
11	0·524	1·048
12	0·522	1·043

Subtracting (3) from (1) and (4) from (2),

$$\theta_1 - \theta_2 = \left[\frac{S_2}{EI_2} - \frac{S_1}{EI_1}\right]\frac{a^2H^2}{3} = \left[\frac{S_2'}{EI_2} - \frac{S_1'}{EI_1}\right]\frac{(1-a)^2H^2}{3} \quad . \quad (5)$$

As the shearing forces at any level are the sum of the forces acting on the stories above,

$$\frac{S_1}{S_1'} = \frac{S_2}{S_2'} = \frac{(n-a)H}{(n+1-a)H} = \frac{1}{k} \text{ (say)}.$$

Substituting in (5), $a^2 = (1-a)^2k$ and $k(1-a) = \frac{a^2}{(1-a)}$. Also

$$a = \frac{(3+2n) - \sqrt{4n^2-3}}{6}$$

is obtained, from which values of a are calculated and given in *Table* 1.

By algebraically equating the bending moments at the connections due to the shearing forces on the columns with the bending moments on the beams:

$$\text{At A: } M_1 = S_1aH + S_1k(1-a)H = S_1H\frac{a}{(1-a)} \quad . \quad . \quad (6)$$

$$\text{At E: } M_2 = \tfrac{1}{2}[S_2aH + S_2k(1-a)H] = S_2\frac{H}{2}\cdot\frac{a}{(1-a)} \quad . \quad . \quad (7)$$

By equating the rotations at the ends of the beams, which are the same as those of the connecting columns,

$\theta_1 = \frac{M_1L}{3EI_3} - \frac{M_2L}{6EI_3}$ and $\theta_2 = \frac{M_2L}{3EI_3} - \frac{M_1L}{6EI_3}$, giving

$$\theta_1 - \theta_2 = (M_1 - M_2)\frac{L}{2EI_3} \quad . \quad (8)$$

Substituting in (8) the values of M_1 and M_2 in (6) and (7), and equating it to the central value of (5),

$$\left(\frac{S_2}{EI_2} - \frac{S_1}{EI_1}\right)\frac{a^2H^2}{3} = \left(S_1 - \frac{S_2}{2}\right)\frac{HL}{2EI_3}\cdot\frac{a}{(1-a)}.$$

$$\frac{S_1}{S_2} = \frac{\left[\dfrac{3L}{EI_3}\cdot\dfrac{1}{4a(1-a)} + \dfrac{H}{EI_2}\right]}{\left[\dfrac{6L}{EI_3}\cdot\dfrac{1}{4a(1-a)} + \dfrac{H}{EI_1}\right]} \quad . \quad . \quad . \quad . \quad . \quad (9)$$

The factor $\dfrac{1}{4a(1-a)}$ tends towards unity as n increases, and for practical purposes may be accepted as unity, as for values of n greater than 4 the error is less than 0·4 per cent. and the effect of wind on any top four stories is generally negligible. Equation (9) may therefore be accepted as

$$\frac{S_1}{S_2} = \frac{\left[\dfrac{3L}{EI_3} + \dfrac{H}{EI_2}\right]}{\left[\dfrac{6L}{EI_3} + \dfrac{H}{EI_1}\right]} \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

At any level $2S_1 + S_2$ is equal to the total shearing force on the stories above; hence the separate values of S_1 and S_2 may be calculated. These values being known, the bending moments on the beams and columns and the shearing force on the beams may be calculated from

$$M_{AB} = S_1Ha\,;\quad M_{AC} = S_1H\frac{a^2}{(1-a)}\,;\quad M_{AD} = S_1H\frac{a}{(1-a)}\,;$$

$$M_{EF} = S_2Ha\,;\quad M_{EG} = S_2H\frac{a^2}{(1-a)}\,;\quad M_{ED} = S_2H\frac{a}{(1-a)}\cdot\frac{1}{2}.$$

Shearing force on beam $= (S_1 + \frac{1}{2}S_2)\dfrac{H}{L}\cdot\dfrac{a}{(1-a)}$. The variable factors for the different values of n are given in *Table* 1.

An alternative and much quicker method of deriving equation (10) is to make the foregoing calculations with the further initial assumptions that $S_1 = S_1'$, $S_2 = S_2'$, and $a = 0{\cdot}5$ at all levels, and that $A = A'$. For the values of bending moments, etc., by this method the shearing force on the outside columns should be the mean of S_1 and S_1', that is $S_1\dfrac{n}{n-\frac{1}{2}}$, and similarly for S_2. The equations for bending moments and shearing forces become

$$M_{AB} = M_{AC} = S_1H\frac{h}{(2n-1)}\,;\quad M_{EF} = M_{EG} = S_2H\frac{n}{(2n-1)}\,;$$

$$M_{AD} = S_1H\frac{2n}{(2n-1)}\,;\quad M_{ED} = S_2H\frac{n}{(2n-1)}\,;$$

shearing force on beams $= (S_1 + \frac{1}{2}S_2)\frac{H}{L}.\frac{2n}{(2n-1)}$. The variable factors for the different values of n are given in *Table 2*.

A comparison of columns 4 and 5 of *Table 1* with columns 2 and 3 of *Table 2* shows that this further approximation gives acceptable values, especially for the moments on the beams. It must be noted, however, that when this method is used the shearing forces are calculated as if they were acting at the connection levels, and in the equations for bending moments and shearing force the factor $\frac{2n}{(2n-1)}$ is replaced by 1.

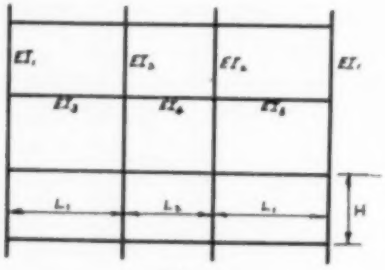


Fig. 3.

The following is an example of the use of the alternative method for a symmetrical frame with four columns as shown in *Fig. 3*. Assuming that

$$\frac{L_2}{EI_4} = m\frac{L_1}{EI_3},$$

then, following the same stages as before:

$$\theta_1 = \frac{2\Delta}{H} - \frac{S_1H^2}{12EI_1}\,;\quad \theta_2 = \frac{2\Delta}{H} - \frac{S_2H^2}{12EI_2}\,;\quad \theta_1 - \theta_2 = \left(\frac{S_2}{EI_2} - \frac{S_1}{EI_1}\right)\frac{H^2}{12}\,;$$

$$M_1 = S_1H\,;\quad M_2 + M_3 = S_2H\,;$$

$$\theta_1 = \frac{M_1L_1}{3EI_3} - \frac{M_2L_1}{6EI_3}\,;\quad \theta_2 = \frac{M_2L_1}{3EI_3} - \frac{M_1L_1}{6EI_3} = \frac{M_3L_2}{3EI_4} - \frac{M_2L_2}{6EI_4} = \frac{m.M_3L_1}{6EI_3}\,;$$

$$\theta_1 - \theta_2 = (M_1 - M_2)\frac{L_1}{2EI_3} = \left[\frac{(1+m)}{(2+m)}S_1 - \frac{m}{(2+m)}S_2\right]\frac{L_1H}{2EI_3}\,;$$

$$\frac{S_1}{S_2} = \frac{\left[\dfrac{6}{(2+m)}.\dfrac{L_2}{EI_4} + \dfrac{H}{EI_2}\right]}{\left[\dfrac{6(1+m)}{(2+m)}.\dfrac{L_1}{EI_3} + \dfrac{H}{EI_1}\right]}.$$

When the beams are of equal stiffness, that is $m = 1$, $\dfrac{S_1}{S_2} = \dfrac{\left[\dfrac{2L_1}{EI_3} + \dfrac{H}{EI_2}\right]}{\left[\dfrac{4L_1}{EI_3} + \dfrac{H}{EI_1}\right]}$.

The bending moment and shearing forces are calculated as in the previous examples.

It may be concluded from these calculations that all members contribute to the distribution of horizontal forces on open frames, and that only very basic assumptions are necessary to give acceptable results. These methods may be adapted to obtain equations for the distribution of shearing forces for frames with any number of columns and with beams of varying stiffnesses.

Proportioning Concrete Mixtures.

MR. M. G. DEMPSTER, Assistant Director of Engineering, Department of Works, Hawthorn, Victoria, Australia, writes as follows.

The comments in the Editorial Note in your number for December, 1954, and the nature of the change in the latest revision of the British Standard for concrete aggregates, emphasize that the problem of specifying a satisfactory aggregate is a difficult one. There is always a tendency to attempt to describe the desired characteristics in detail with allowable tolerances. However, it is usual to require that the aggregate shall also produce certain strengths, and this is usually regarded as the overriding consideration. If we are prepared to accept the idea that sand and stone are cheap inert distenders of a more expensive cement paste, the quality and composition of which are to govern the quality of the concrete, many of the difficulties disappear.

The Australian Department of Works has developed a simple method based on this idea, and the first step is to find out how much sand can be mixed into a given quantity of cement paste of predetermined water-cement ratio. The criterion for workability is somewhat similar to Atterburg's lower plastic limit and is determined by a trowel. The mortar should be self-healing when cuts are made in the top with a trowel, and should just bulge rather than flow when it is pushed up to a vertical face about 1-in. high. Obviously the test integrates the grading and surface characteristics of the sand, and the more sand that can be mixed in the better is the sand for concrete making. A specification for sand, in so far as grading and particle shape are concerned, could be that when not less than 4 lb. of the sand are mixed with a cement paste containing 1 lb. of cement and one Imperial pint of water, the consistency shall be as specified above.

The principle of the gradual addition of sand to a cement paste of predetermined properties can be extended to the determination of the quantity of coarse aggregate that can be mixed into a predetermined mortar, and this completes the whole work of proportioning a concrete mixture. In the second stage, the mortar as determined for rating the quality of the sand, has too much sand in it to allow much stone to be added and the sand content of the trial mortar must be reduced by about 3 per cent. for each reduction of 0·1 in the water-cement ratio. For example, if a trial mortar showed that 2 lb. of cement with 1·2 lb. of water, that is a water-cement ratio of 0·6, could take 6 lb. of a certain sand at "lower plastic limit," then the sand content of the trial mortar for concrete should be reduced by about $6 \times 6 \times \frac{3}{100}$, or by 1·08 lb. to 4·92 lb. A suitable mortar into which to mix the coarse aggregate would then be 16 lb. of cement, 9·6 lb. of water, and 39·36 lb. of sand.

It will be found that this method, when applied to sands and stone graded in accordance with the recommendations of Bolomey, will ensure the same mixture as might have been determined by sieve analysis, although the operator may be quite unconscious of it. The method is particularly suitable where aggregates do not comply with a specified grading, in which case there are no alternatives to trial methods. It is emphasized that quite good concrete can often be made at the expense of the addition of a little extra cement.

A Prestressed Precast Aqueduct.

THE prestressed concrete aqueduct shown in the illustrations is at Barrhill, Ayrshire. The structure is made of separate pieces through which extend longitudinal holes. The parts were laid end to end with mortar joints ½ in. thick between, and were prestressed by high-tensile wires passing through the holes and tensioned against the end units. This is the first of three aqueducts of differing spans to be erected in the Scottish Region of British Railways. The units are 3 ft. 4 in. long and have an average wall thickness of 4½ in., the channel being 3 ft. 3 in. wide by 2 ft. deep inside. Continuity of the ducts at the joints is obtained by the use of short rubber bushes. The units were cast from one mould, the holes for the eight prestressing cables being formed by oiled rods which were withdrawn as soon as the concrete had set, and they were compacted on a vibrating table. There are twenty prestressing wires of 0·276 in. diameter in two four-wire parabolic cables and six two-wire straight cables, each wire being tensioned to 7650 lb. The units were made and prestressed by Messrs. Girlings Ferro-Concrete Co., Ltd. The aqueduct, which is 33 ft. 9 in. long, was transported by rail to the site and erected, and the inside was subsequently waterproofed with a bituminous compound. The design and erection were under the supervision of the Chief Civil Engineer, British Railways (Scottish Region).



Fig. 1.—A Prestressed Precast Aqueduct.

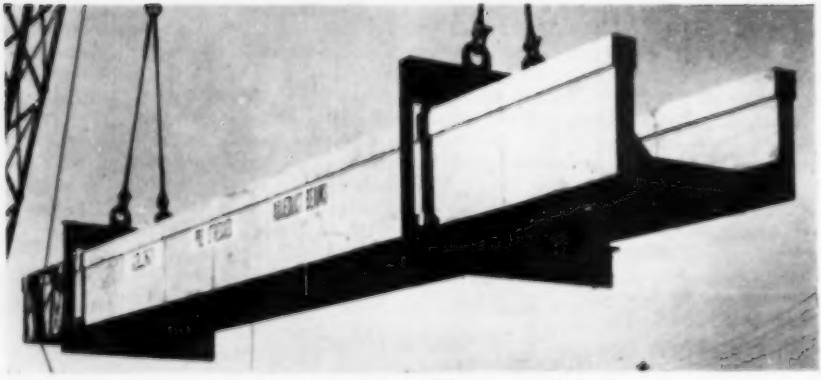


Fig. 2.—Erecting the Aqueduct.

Some Recent Reinforced Concrete Bridges.

At the annual meeting of the Pavings Development Group of the Cement and Concrete Association, held in London in March, the following papers were read.

"Reinforced Concrete Bridges Constructed since the War", by Mr. W. A. Fairhurst.

"Some Prestressed Concrete Bridges Constructed on the Freyssinet System", by Mr. A. J. Harris.

"Some Prestressed Concrete Bridges Constructed on the Lee-McCall System", by Mr. R. T. Betts.

"Some Prestressed Concrete Bridges Constructed on the Magnel-Blaton System", by Professor G. Magnel.

"Prestressed Concrete Bridges: Pretensioned and other Systems", by Mr. A. W. Hill.

"The Application of Lessons learnt in Airfield Construction to the Construction of Concrete Roads", by Mr. J. M. Laing.

"Concrete Road Construction in the Netherlands, with Special Reference to the new Motor Roads", by Mr. J. C. N. Ringeling.

Mr. Fairhurst, of Messrs. F. A. Macdonald & Partners, dealt with the æsthetic aspect of the design of reinforced concrete bridges, and illustrated his remarks with illustrations of bridges which in his opinion had special merit. The following is an abstract of Mr. Fairhurst's paper.

Unfortunately, due to the serious neglect by the authorities of roads and bridges in this country during the past ten years, not a single British bridge could be seriously considered even as a competitor for this distinction.

The Gueuroz bridge (*Fig.* 1) at Gueuroz, Switzerland, designed by Professor A. Sarrasin, is a slender and graceful structure including two amazingly slim arch ribs of 323 ft. span. These ribs are 2 ft. wide and only 3 ft. 7 in. deep at the crown and 6 ft. 7 in. deep at the springings. Such small depths are only possible because of the deep parapet girders which act as stiffeners. To give the maximum security to vehicles solid parapets have been used and these serve as stiffeners in the arch ribs at the centre. This large depth of the stiffening girders serves to emphasize the achievement of the slender arches. It would have been almost impossible to provide the overall stiffness required without beams of the depth used. Vertical posts of tee section carry the deck, and everything possible has been done to increase the general slenderness of the design. This type of bridge is a kind of inverted suspension bridge and requires very good workmanship if the reinforcement



Fig. 1.—Bridge at Gueuroz, Switzerland.



Fig. 2.—Bridge at Rosshaupten, Germany.

is to be properly protected against the elements.

The bridge (*Fig.* 2) over the Tiefe Tal at Rosshaupten, Bavaria, designed by E. Schwaad and A. Gattnar, also has a glorious setting and the design is a particularly pleasing one. Two arch ribs of box section span 255 ft. with a rise of about 41 ft. The arch ribs are surmounted by thin posts which carry the deck. A simple metal railing completes a picture worthy of its background. As the arch is of parabolic form, even the foreshortened view (*Fig.* 3) looks well. *Fig.* 4 indicates the nature of the centering. The construction of a bridge in a ravine of this kind is always difficult and the three-hinged truss used for the centering was in itself a fine engineering achievement. Jacks were built in at the crown to allow for distortion due to the shortening of the arch. Two of the principal features in

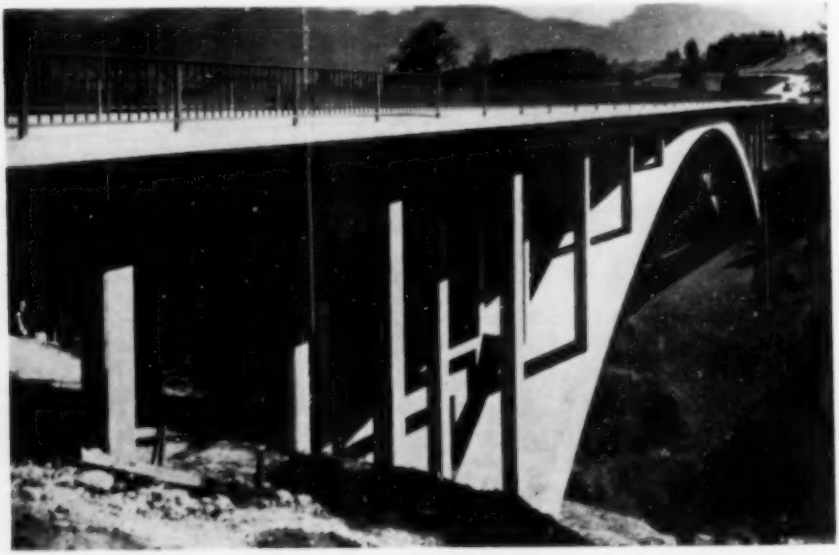


Fig. 3 – Bridge at Rosshaupten, Germany.



Fig. 4.—Bridge at Rosshaupten, Germany.

the success of this design are the uninterrupted sweep of the road line and the graceful curve of the soffit of the arch ribs. The absence of distracting detail combined with these features make this an outstanding contribution to bridge design.

It is interesting to compare the Rosshaupten bridge with the Gueuroz bridge and to observe the great difference in treatment of the two structures at deck level. In one case there is a light metal railing to increase the lightness of the deck construction and in the other case a solid parapet which, together with the depth of beam below the deck, adds to the effect of lightness of the arch and vertical posts.

The bridge designed by Dr. Antonio Alves de Noronha over the Rio das Antas, Brazil [illustrated in this journal for June, 1954], is claimed to be the second largest reinforced concrete arch span in the world and nothing has been done to detract from the beauty of the two great arch ribs. The road-line sweeps across the valley and blends well with the two great arch ribs. The arches are supposed to be of catenary form, which is satisfactory from an æsthetic standpoint for a high rise, even in the foreshortened view.

One of the flattest arches ever constructed was used in the San Niccolò bridge, Florence. This bridge (*Fig.* 5) has a width of 70 ft., a span of 303 ft., and a rise of 28 ft. 6 in., giving a span/rise ratio of 11·4. The arch shape is parabolic, giving a satisfactory appearance from any angle. The thickness at the crown is 4 ft. 5 in. and at the springings 11 ft. 8 in., with a linear variation in thickness between crown and springings. The arch is of box section with eight vertical stiffeners each 9 ft. apart. The vertical ribs are joined by top and bottom slabs varying in thickness from 1 ft. to 3 ft. 3 in. The abutments are of cellular construction and the design has many interesting details. The parapet is an original design. It is unfortunate that some flaws in the concrete are seen where the spandrel



Fig. 5.—San Niccolò Bridge, Florence, Italy.



Fig. 6.—Bridge at Bezons, France.

walls meet the arch slab. The problem of arranging lifts of concrete so that construction joints will not be unduly evident is a difficult one, and many fine structures have been harmed in this way. The engineer is Dott. Ing. R. Morandi.

The Jacques-Boulloche bridge (*Fig.* 6) at Bezons is a girder bridge with beautiful soffit lines, which has a central span of 312 ft. and two side spans of 176 ft. There is a hinge at the crown of the central span and rocker supports at the ends of the side spans and at the river piers. The ribs have a depth of 4 ft. 9 in. at the crown and about 26 ft. at the central supports. To avoid obstructing river traffic the box girders were built with the aid of steel lattice girders spanning from the abutments to the central piers. The lattice girders were made of built-up sections bolted together with Bailey bridge parts. The reinforced concrete parts of the bridge over the piers were cast first and then used as supports for the lattice girders by means of joists, as the girders were launched from the bank to the central pier. Construction then proceeded simultaneously on the other side of the pier and, after portions of the concrete had hardened, the joists supporting the lattice girders were moved forward in order to shorten the span. This bridge was a fine technical achievement in view of the foundation and construction difficulties, and its lines are extremely pleasing. It is unfortunate that the system of construction makes it exceedingly difficult to produce a fair face to the spandrel walls and there is much to be said for using facing slabs to the spandrels. The consulting engineers were MM. A. Caqot and R. Brocard, and the designers were l'Entreprise Vandewalle.

A bridge (*Fig.* 7) over the river Meuse at Liège has a pleasing appearance and the good lines of this city bridge are not



Fig. 7.—Bridge at Liège, Belgium.

spoiled by the sculpture on the cutwaters and approaches. It was designed by Ponts et Chaussees du Sorrice des Routes de la Province de Liège under the direction of M. Honorez.

Waterloo bridge over the river Thames is worthy of comparison with almost all the bridges discussed, and British engineers only need the opportunities to emulate their foreign contemporaries.

Permissible Stresses in Steel in Germany.

A DRAFT German code* deals with riveted and bolted steel structures other than railway and road bridges, and a new provision whereby permissible stresses can be varied according to the load for which the structure is designed may be of general interest. The following three cases are distinguished: (1) Principal load comprising dead weight, live load and snow, but not wind. (2) Principal load plus all secondary loads, including wind forces, braking and horizontal forces due to cranes, and temperature variation. (3) Principal load in conjunction with the most unfavourable combination of secondary loads.

The permissible design stresses for mild steel structures in which dynamic forces and reversals of stress are limited are as follows: Direct compressive stress, and compressive stresses due to bending where the lateral buckling and overturning forces have not been investigated: Case 1, 8·89 tons per square inch; Cases 2 and 3, 10·2 tons per square inch. Direct tensile stresses and tensile stresses due to bending when there is no lateral buckling: Case 1, 10·2 tons per square inch; Case 2, 11·1 tons per square inch; Case 3, 11·75 tons per square inch. Shearing stress: Case 1, 5·8 tons per square inch; Case 2, 6·4 tons per square inch; Case 3, 6·8 tons per square inch. Corresponding British standards limit tensile and compressive stresses to 10 tons per square inch and shearing stresses to 6·5 tons per square inch.

* DIN 1050. "Genietete und geschraubte Stahlbauton ausser Eisenbahn und Strassenbrücken." [Berlin: Wilhelm Ernst & Sohn. 1954. Price 1.30 D.M.]

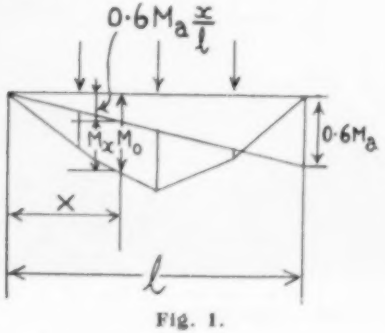


Fig. 1.

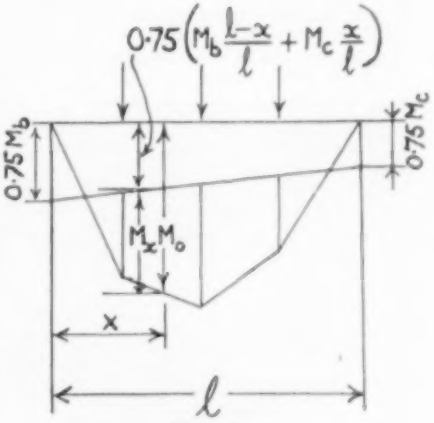


Fig. 2.

The suggested approximate method for calculating the bending moments in continuous beams of equal span and loading, or nearly so, for any combination of loading is

End spans: $M_x = M_o - 0{\cdot}6M_a\frac{x}{l}$ (*Fig.* 1),

Intermediate spans:

$$M_x = M_o - 0{\cdot}75\left(M_b\frac{l-x}{l} + M_c\frac{x}{l}\right)$$

(*Fig.* 2), where M_o is the bending moment for a beam freely supported, M_a is the bending moment for a beam fully fixed at one support (end span), and M_b and M_c are bending moments for a beam fully fixed at both supports (intermediate span).

A Church in Morocco.

THE Église du Sacré-Cœur (*Fig.* 1) in Casablanca, French Morocco, is the largest Christian church in North Africa. Apart from the masonry walls it is built entirely of reinforced concrete. The cross section (*Fig.* 2) shows the main structural features, comprising five vaults supported on columns of 2 ft. 7½ in. diameter. The main dimensions are: internal length, 260 ft.; internal width, 114 ft.; height of the principal nave, 103 ft.; height of the towers, 186 ft. The vaulted roof consists of two reinforced concrete shells separated by a layer of cork, the total thickness being about 7 in.

The architect is M. Paul Tournon. Work on the church was started in the year 1930 but was interrupted by the war and not recommenced until 1949, the post-war work being carried out by the Société Marocaine des Entreprises Truchetet-Tansini et A. Dodin. The foregoing is abstracted from the February, 1955, number of the French journal "Travaux."

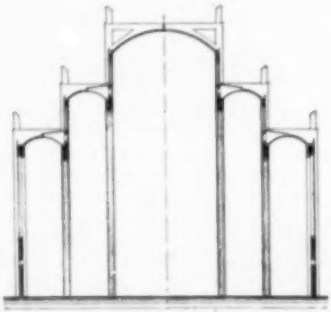


Fig. 2.—Cross Section through Church.

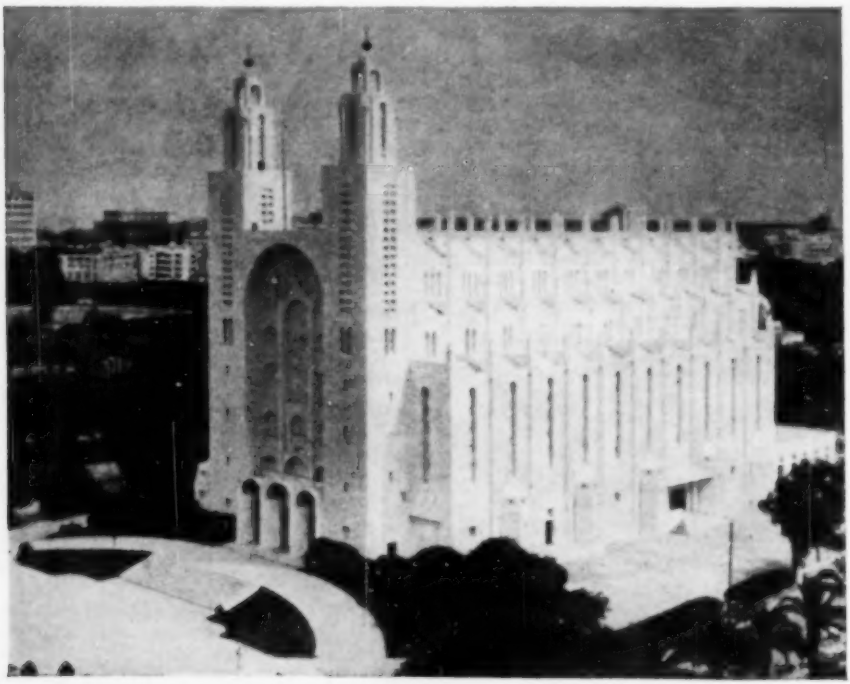


Fig. 1.—Église du Sacré-Cœur, Casablanca.

A Prestressed Pipe-Bridge.

PRECAST ON THE BANK OF THE RIVER.

A BRIDGE has been built at Gunthorpe, near Nottingham, to carry two 21-in. water-mains across the river Trent. In order not to obstruct river traffic during construction, the bridge was built on the bank and launched across the river.

The bridge (*Figs.* 1 and 2) has a single top boom, a bottom member consisting of two stiffening parapet girders with a light deck between, and triangular hangers.

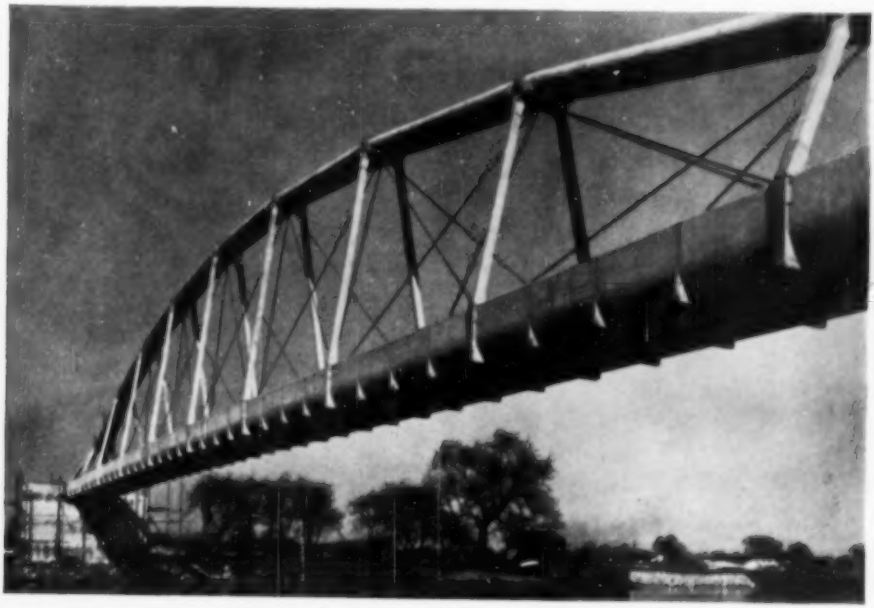


Fig. 1.

The abutments are vertical slabs of prestressed concrete. The bridge has a span of 250 ft. and a total width of 10 ft.; the distance at mid-span between the deck and the boom is 28 ft. The pipes are in lengths of 25 ft. and are carried by the hangers which are at 25 ft. centres and occur at the joints between the pipes. Each hanger is prestressed with one cable of twelve wires.

The boom is a hollow rectangle 3 ft. 4 in. wide by 1 ft. 4 in. deep with rounded corners; the wall and a central web are 3 in. thick. Each of the ten bays between the hangers comprises four sections of precast concrete, each about 6 ft. long, which were assembled and stressed together on the ground with one cable of twelve wires. When completed each bay was lifted into position, and no further prestressing was applied. At each end the boom is divided into two solid arms, circular in cross section, which allow passage for the pipes through the end-block and into the abutment. These arms bear on Freyssinet hinges on the end-block. The end-blocks are of reinforced concrete cast in place and prestressed transversely with fourteen cables each comprising twelve wires. Mild steel bars crossing diagonally between the hangers are used as bracing, and are protected against corrosion by zinc paint.

The girders comprise four precast sections, each about 6 ft. long, in each bay; they are 3 ft. 8 in. deep and 3 in. thick,

with a top flange, projecting on the inner side, containing a groove for the prestressing cables. The deck and girders are braced by prestressed precast units. The deck (*Fig.* 3) is constructed with "Shishkoff" hollow precast slabs 11 in. wide, 4½ in. deep, and about 6 ft. long, with walls and flanges ½ in. thick spanning between the transverse braces.

The deck and girders were prestressed together with fifteen 12-wire cables, three of which are in the groove in the top flange of each girder and the other nine centrally on the floor slabs. The anchors of the cables are contained in the end-blocks. Concrete was laid over the slabs and the cables.

One of the abutments is provided with

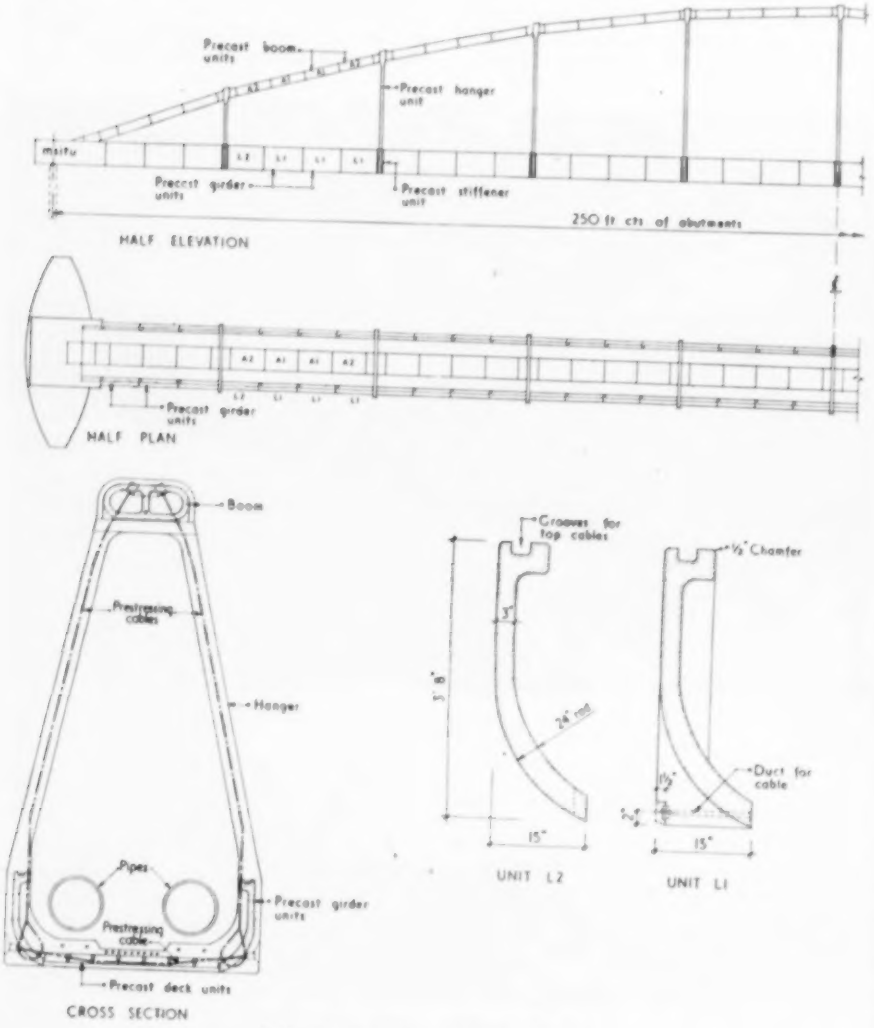


Fig. 2.—Details of Pipe-Bridge.

Freyssinet hinges at the top and bottom to allow for expansion and rotation of the bridge; the other abutment has a hinge at the top to allow for rotation. The abutments are founded on reinforced concrete slabs on Franki piles. Around each abutment a prestressed wall 5 in. thick was built to protect the pipes and the approach ladder.

The bridge, which weighed nearly 200 tons, was assembled on the north bank of the river, and then launched (*Fig.* 4) and supported on temporary steel abutments while permanent concrete abutments were being built. A railway track was laid leading down to the river on which were placed two trolleys; between the trolleys, scaffolding was erected and the bridge built at a level high enough to allow the river to be opened to traffic immediately the bridge had been launched and secured to the temporary abutments. When the construction was completed the railway track was extended on to a timber jetty built on the south bank, where a temporary abutment was erected. The leading trolley carrying the south end of the bridge was moved on to a pair of pontoons carrying rails matching those on the jetty. The pontoons were hauled

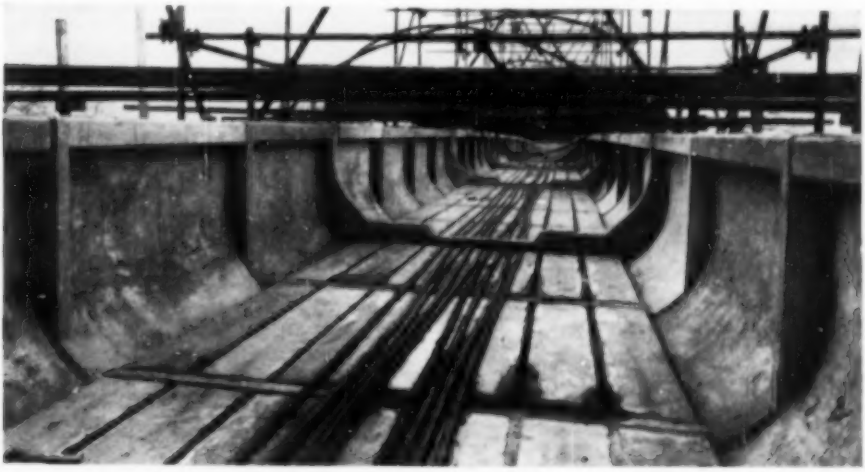


Fig. 3.—Prestressing Cables in Precast Deck.



Fig. 4.—Towing the Bridge Across the River.

across the river by winches and the south end of the bridge rolled on to the landing up to the abutment. The second temporary abutment was then assembled at the north end and the bridge was jacked on to the abutments to a height of 5 ft. above its final level so that it could be placed on the permanent supports without sideways movement. The river was opened again while the permanent abutments were being built.

The proportioning of the concrete was left to the contractor; the minimum strength required was 6000 lb. per square inch at 28 days, except for the end blocks where 8500 lb. at 28 days was required. Ultrasonic tests were carried out on the concrete of the boom to determine the modulus of elasticity so as to verify the correctness of the calculations with regard to buckling. To test the completed bridge, water from the river was pumped into the trough formed by the end blocks, parapets, and deck to 1¼ times the working load; the deflection was 1¼ in., and there was complete recovery when the load was removed.

The City Engineer of Nottingham, Mr. R. M. Finch, O.B.E., M.I.C.E., supervised the work for the Water Engineer, Mr. B. W. Davies, M.I.C.E. The design was by the Pre-Stressed Concrete Co., Ltd., and Messrs. Crowley, Russell and Co., Ltd., were the main contractors. The Croft Granite Brick & Concrete Co., Ltd., were sub-contractors for the precast concrete, and the Franki Piling Co., Ltd., drove the piles. The ultrasonic testing was carried out by the Cement and Concrete Association.

Steam Curing on the Site.

By the use of steam curing it was possible to lift some large prestressed beams for a bridge at Den Helder, Holland, the day after the concrete was cast. The beams are tee-shape with a top flange 3 ft. 4 in. wide by 8 in. thick, a web 6 in. wide at the top increasing to 1 ft. 2 in. at the bottom, a total depth of 5 ft., and a length of 90 ft. The ends were precast and fully cured in advance. When the concrete for the intermediate part of the beam was cast a wooden cover (see *Fig.* 1) was placed over it and steam at a temperature of about 130 deg. Fahr. admitted for a period of six hours. The steam was provided by a railway locomotive. Next morning the concrete had a compressive strength of about 2500 lb. per square inch, and sufficient of the prestressing cables were tensioned to permit the beam to be lifted off the casting bed and taken by a crane to the storage area. This bridge is fully described in "Polytechnisch Tijdschrift" for November, 1954.

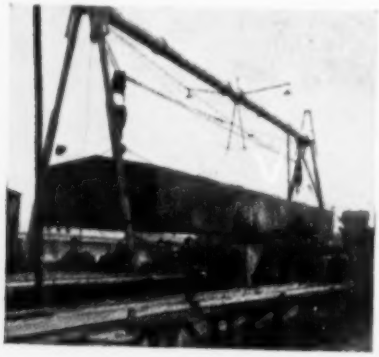


Fig. 1.—Cover for Steam Curing.

"Work Study" in Building.

A COURSE of "work study" lasting two days was held recently for the employees of Messrs. Richard Costain, Ltd., Messrs. Holland & Hannen and Cubitts, Ltd., Messrs. John Laing & Son, Ltd., the Unit Construction Co., Ltd., and Messrs. George Wimpey & Co., Ltd. The lecturers comprised men from large companies in other industries, the Trades Union Congress, a "work study" school, and industrial consultants. The purpose of the course was to discuss means of improving the efficiency of the building industry.

Construction of Multiple-story Flats.

THE following is an abstract of an address given by Mr. C. D. Mitchell, of Messrs. Wates, Ltd., at a Symposium on High Residential Flats held recently in London at the Royal Institute of British Architects, when Mr. Mitchell was invited to give the point of view of the contractor on the rapid construction of tall buildings.

In this country we had much to learn from elsewhere, particularly America. During a recent visit to the U.S.A. he was greatly impressed by the teamwork of all concerned, but principally that of the architect, engineer, and contractor, long before the work was due to start. In this country the contractor's experience in such matters as plant, costs, and methods was too often neglected. No doubt many architects had designed what they thought was an easily-built structure only to see their constructional conception disregarded by a contractor whose sole qualification was that he was the cheapest of nation-wide tenderers, who was given a roll of drawings (often incomplete), a list of sub-contractors with whom he had never worked before, and instructions to start on the site within seven days. A step towards more organised production was taken when his Company had the opportunity of building five blocks of 11-story residential flats at Trinity Road, Wandsworth, for the London County Council. Each block was about 64 ft. square with a reinforced concrete frame and cavity outer walls of 4½-in. brickwork and 3-in. clinker blocks. Each block with its penthouse was about 120 ft. high, and had two lifts and two staircases. The total cost was about £450,000, and the contract was obtained in limited competition. [Some notes on this work were given in this journal for January 1955.]



Fig. 1.—Erecting Precast Stairs.



Fig. 2.—Erecting a Precast Landing.

Work on the foundations of the first block commenced in February, 1954, and in February, 1955, the first block was completed, the second was within a few weeks of completion, the third was plastered, the fourth had the frame completed and half the external walls built, and the last block had the reinforced concrete frame complete up to the seventh floor. It was expected that the whole contract would be completed by July, 1955, or four months earlier than the contract date.

At the outset a complete set of drawings was provided, and they were told that suggestions to increase speed or ease of construction would receive consideration. The co-operation of the architect, the consulting engineers and the District Surveyor laid the foundation for the speed with which the work progressed.

To a contractor the "bones" of the building were the most important. In this case, the "bones" comprised an in-situ reinforced concrete frame with precast staircases. But they did not like mixing

reinforced concrete with general building work, or enclosing a concrete frame in scaffolding that would be in the way of the bricklayer and other trades. They did not like shuttering horizontal beams, with carpenters working on trestles fixing timber 8 ft. or so in the air. They did not like concreting walls in 3-ft. lifts. They preferred to eliminate many of the older methods and to adopt new and simpler ones.

A tower crane was used. This machine is electrically driven and self-propelled on rails ; the height of the mast in its travelling position is 125 ft., and in a fixed position it can extend to a height of about 300 ft. The jib is horizontal, 65 ft. 6 in. long, fitted with a travelling bogey capable of lifting 3 tons at 15 ft. to a minimum of 17½ cwt. at 65 ft. The hoisting speed is 197 ft. a minute. The mast is extended 22 ft. at a time by electrically-driven jacks. The planning of the work centred around the crane and its capacity.

All the balcony-slabs and horizontal beams were precast, thus eliminating much carpentry on the structure. The walls were concreted to their full story-height of 8 ft. 2½ in., using the largest possible shutters.



Fig. 3.—Story-height Shutter with Working Platform attached.

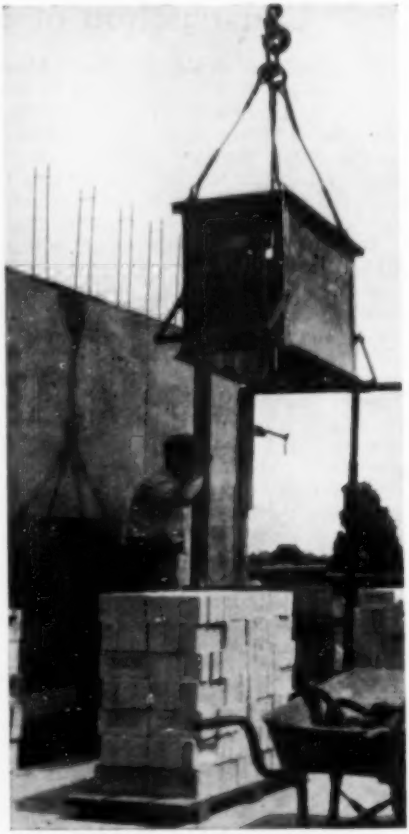


Fig. 4.—The Brick Hoist.

A scale model of a floor was made, showing clearly the parts to be precast and those to be cast in place, and this proved to be of great value. The balconies and stairs were made in a factory off the site, but the beams were cast on the site using the crane-track as a casting bed. Landings as well as flights of stairs (*Figs.* 1 and 2) were precast with a granolithic finish. As each floor of the structure was built, the landings and stairs were placed by the crane on to precast concrete nibs cast into the side walls and were protected by timber casings. Access to each floor was thus immediately given. The fronts of the balconies were made in one piece, and were quickly placed in position on the precast

balconies, the fixing bolts being grouted in pre-formed holes.

The shutters comprised 18-mm. plywood on 3-in. by 2-in. frames. Where possible the panel was of a size completely to shutter the wall for which it was to be used (*Fig.* 3), and blockings for all the chases and holes were incorporated. In addition, a working platform was fixed to each shutter so that when the shutter was in position the working access was also provided. The shutters were held together by bolts passing between walings.

The floor shuttering comprised telescopic centres spanning generally from wall to wall and covered with sheets of plywood. Each sheet of plywood measured 8 ft. by 4 ft. and was marked to show the position of ventilation ducts, holes through the floor, and the like, so that it was important to place them in the same position on each floor.

Instead of using steel hoops to join the two layers of vertical reinforcement in the walls, steel "ladders" were made with ¾-in. diameter vertical bars to which ¼-in. diameter bars were welded at the required spacing. Many thousands of these "ladders" were made, thus reducing the site labour and considerably improving the speed of erection.

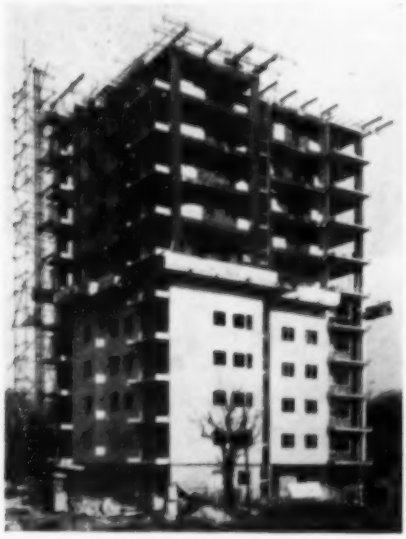


Fig. 5.—Suspended Scaffold for Bricklayers.



Fig. 6.—Suspended Scaffold in use for Painting Window Frames.

A 14/10 rotary-drum mixer, a mobile weigh-batching plant for the aggregates (supplied by means of a trench-crane equipped with a clamshell and mounted on a platform), and a cement silo with automatic weighing equipment (fed by a pressurized tank) were used. Only two men were needed to operate this plant. Special buckets were made, one for concreting 6-in. walls and columns and the other for concreting floors. The bucket for concreting the walls rested on top of the shutter, and had a protruding lip to direct the concrete into the shutter without spilling; each bucket had the same capacity as the drum of the mixer.

It was planned to construct each floor of the frame in seven working days, and the quickest time was 4½ days; this was achieved with five concretors, ten carpenters, five carpenters' labourers, four steel fixers, and one crane driver.

As the crane was not fully employed on the construction of the frame, it was used to place on each floor the bricks and clinker blocks for the external walls and the internal partitions. The position and size of each stack were agreed

by the engineers, and sufficient pallet-boards were made so that bricks and slabs could be unloaded from lorries on to the pallet-board and so save double-handling. The pallet-boards and bricks were lifted into position by means of a brick-skip (*Fig.* 4). The bricks were hoisted immediately after striking the wall shutters; a great deal of manual labour was saved and the bricks and slabs were available where required. Since props were not generally required under the floor shuttering, the presence of the bricks was not a hindrance.

When the roof was asphalted, steel outriggers were erected on the roof and from this the scaffold for the erection of the brick walls was hung. As the scaffold (*Fig.* 5) was raised, bricks from each floor were passed on to it. Mortar for the bricklayers and materials for the plasterers were supplied by means of a hoist working at 300 ft. per minute, because by this time the crane had passed on to the next block. The outer wall was constructed at a rate of 2½ floors per week, that is four to five weeks per block. This method of scaffolding enabled bricklaying to proceed without interruption, kept the work always at a reasonable height, and prevented the staining of the work which often occurred when a fixed scaffold was used. The bricklayers having raised the scaffold to the roof, the glazing and painting of the windows was carried out from the scaffold on its way down (*Fig.* 6). The suspended scaffold and the winches used for raising and lowering it are seen in *Fig.* 7. The suspended scaffold was enclosed with curtains, so helping to reduce the sense of height; on another contract for twenty blocks of multiple-story flats it was hoped to fit this type of scaffold with overhead cover as well, so as to give complete protection in all weathers.



Fig. 7.—Suspended Scaffold, showing Winches for Raising and Lowering.

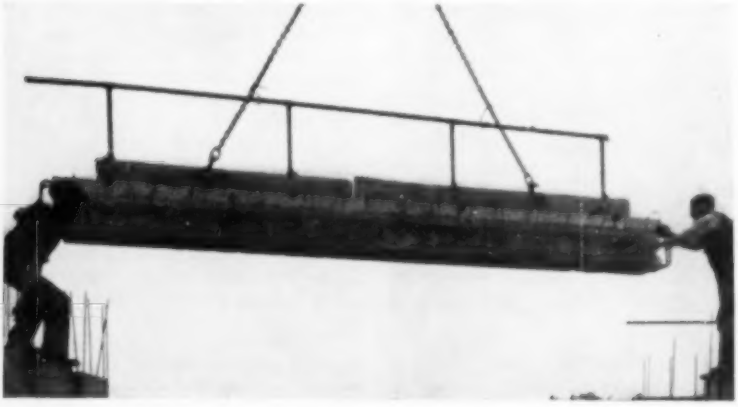


Fig. 8.—Erecting a Precast Beam with Guard-rail and Toe-board Attached.

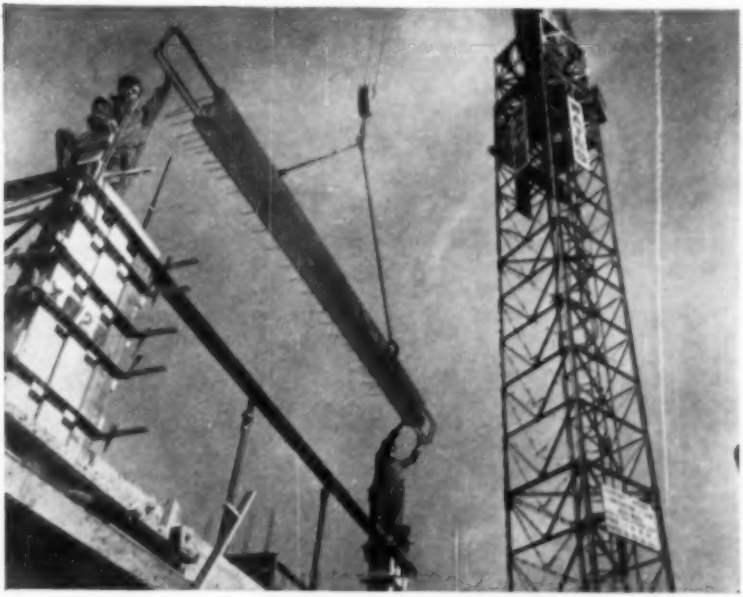


Fig. 9.—Erecting a Precast Beam with a Tower Crane.

Whilst the external wall was being erected, all trades worked under cover of the roof. The number of men employed was sufficient to build six completed flats per week.

By starting the blocks at intervals, maximum use was made of the repetitive nature of the work (about forty floors were the same), and small but efficient gangs of men could be quickly trained for the work.

Each external beam was fitted with a metal guard-rail and toe-board (*Fig.* 8), fixed by bolts passing through holes formed in the beam, so that when the beam was in position the protection was already there; this arrangement proved entirely satisfactory. The erection of a precast beam is shown in *Fig.* 9.

The provision of passenger lifts for the men was considered, but the buildings were not tall enough to warrant the expense. Lavatories were provided on a number of floors. As a precaution against accidents from falling tools and materials, a chestnut-pale fence was erected around each block, some 15 ft. away, and the only entrance was provided with a corrugated-iron roof.

Experience on these buildings confirmed his view that reinforced concrete buildings of this kind had many advantages over steel-frame buildings, and the speed of construction disposed of the often-repeated claim that steel-frame buildings were quicker to erect.

Dr. J. L. Martin, M.A., F.R.I.B.A., is the Architect of the London County Council, and Mr. H. Whitfield-Lewis is the Principal Housing Architect. The consulting engineers are Messrs. Ove Arup & Partners. The contractors are Messrs. Wates, Ltd.

Book Reviews.

"Mix Design and Quality Control of Concrete." Proceedings of a Symposium held in London in 1954. [Obtainable from Concrete Publications, Ltd. Price 45s.; 9.50 dollars in Canada and U.S.A.]

THIS volume of 548 pages comprises the papers read at a symposium held under the auspices of the Cement and Concrete Association in conjunction with organisations representing the reinforced concrete, prestressed concrete, and precast concrete industries in Great Britain. The papers are as follows:

Basic principles of concrete mix design, by J. D. McIntosh; Concrete mixes for various building purposes, by N. Davey; Design of high-strength concrete mixes, by H. C. Erntroy and B. W. Shacklock; The design of concrete mixes on the basis of flexural strength, by P. J. F. Wright; Mix design and abrasion resistance of concrete, by C. L. a'Court; Mix design for frost resistance, by A. R. Collins; Design of concrete mixes for compaction by surface vibrators, by R. H. H. Kirkham; The effect of the vacuum process on concrete mix design, by D. F. Orchard; Steam curing and its effect upon mix design, by A. G. A. Saul; A classification of natural sands and its use in concrete mix design, by A. J. Newman and D. C. Teychenné; The control of concrete quality: a review of the present position, by F. N. Sparkes; Methods of achieving control of quality, by L. J. Murdock; Control of concrete quality on the small site, by J. H. Spanton; Quality control and its effect on structural design, by F. G. Thomas; Quality control for precast concrete, by F. Cornelius; Economic factors in the choice of aggregate grading in relation to quality control, by D. A. Stewart; Quality control for road and airfield construction, by J. M. Fisher; Quality control for mass concrete with special reference to dams and related hydraulic structures, by William Dick; Ready-mixed concrete: quality control refinements, by L. Boyd Mercer; Some problems involved in destructive and non-destructive testing of concrete, by R. Jones and P. J. F. Wright; The application of statistics to concrete quality, by F. R. Himsworth; Methods of specifying concrete, by A. R. Collins.

The discussion on each of the papers is given, and these form a valuable feature of a volume that presents modern ideas on the production of concrete with the properties required for any particular purpose.

"The Value of Good Design." (London: The Council of Industrial Design. Price 2s.)

THIS is a report *on* the Scottish Design Congress held in Edinburgh early in 1954, and is based on papers submitted by manufacturers, shop keepers, designers, and others. It is not a report *of* the Congress, and none of the papers is given in full. Rather it is a commentary on the Congress, in which some passages and some sentences are reproduced from the papers and linked together by the editor. It would have been better to have printed the papers in full and allow the reader to read, and form his own opinions on, all the views expressed at the Congress.

"Architects' Detail Sheets." Second Series. (London: Iliffe & Sons, Ltd. Price 25s.)

THIS volume comprises 96 sheets of architectural details that have appeared in "The Architect and Building News." The details are dimensioned and reproduced to a large scale, and each is accompanied by one or more photographs. The subjects relate to balconies, entrances and shop fronts, fireplaces, fittings, staircases, wall details, windows, and miscellaneous. None of the details relates particularly to concrete. The book should appeal chiefly to architects who are interested in unusual, or what is sometimes called "ultra-modern", design.

"Baumaschinen-Wartung." By H. Ilsemann. (Berlin: Wilhelm Ernst & Sohn; Price 9.80 D.M.)

THIS booklet is a guide for the use of those responsible for the maintenance of plant on civil engineering works. The equipment dealt with includes plant for mixing, distributing and placing concrete, excavating machinery, lifting tackle, cranes, pile-drivers and extractors, compressors, pumps, motors, concrete breakers and stone crushers, and road finishers.

"Kempe's Engineers' Year-Book." [London: Morgan Brothers (Publishers), Ltd. Price £3 15s.]

THIS well-known compendium on all branches of civil, mechanical, and electrical engineering was completely revised last year, and little change has been found necessary in the sixtieth (1955) edition except to deal with later developments in quickly-developing sciences such as electronics. The work is in two volumes comprising 3000 pages.

New System of Construction.

A NEW method of precast concrete construction, known as the Cranley system, is shown in *Fig.* 1.

The posts and rafters are cast separately and bolted together on the site. The roof may be of asbestos-cement sheets. The walls may be of asbestos-cement sheets, bricks, or concrete blocks; a special shape of cavity block is made for the purpose. The system has been used for single-bay frames, spaced at 12 ft. 6 in. or 15 ft. centres, with clear spans up to 45 ft. and a maximum height to the eaves of 16 ft. Precast concrete purlins connect the frames, and slots are cast in the posts to accommodate the wall panels and precast concrete window frames. Frames for multiple-bay structures are also produced, and the system has been adapted to the construction of two-story build-

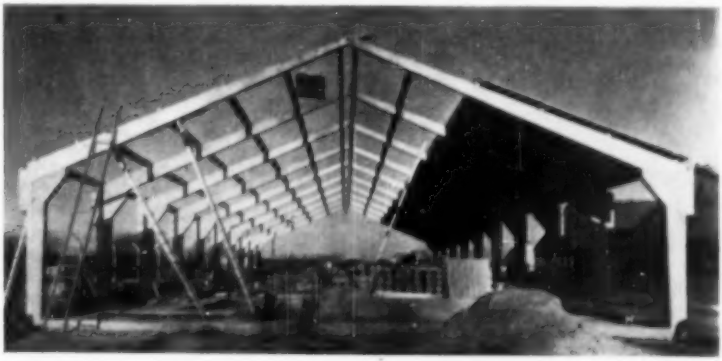


Fig. 1.

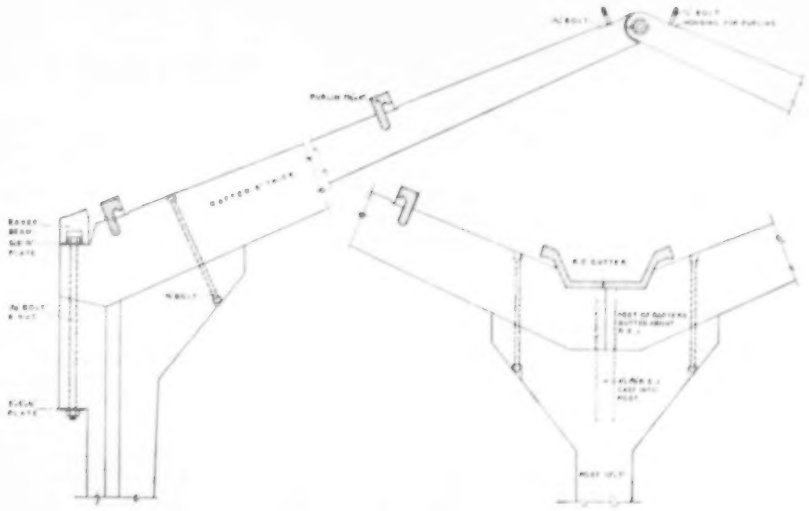


Fig. 2.

ings. Details of the frames are given in *Fig.* 2.

A single frame of 34 ft. overall width and a height of 16 ft. to the eaves has been tested by loading it to destruction. The frame was designed to support itself and a live load of 15 lb. per square foot on a bay 15 ft. wide. Failure by shear at the ridge occurred under a load equal to the dead load plus 3¼ times the design live load; the deflections immediately before failure were 3·39 in. at the ridge and 0·87 in. at the eaves. No sign of lateral instability was noticed. The shape of the blocks supplied to form a cavity wall is shown in *Fig.* 3. These are 8⅞ in. deep by 6 in. wide overall by 1 ft. 2 in. long. The system is operated by Messrs. F. & D. M. Hewitt, Ltd., of Cranleigh, Surrey.

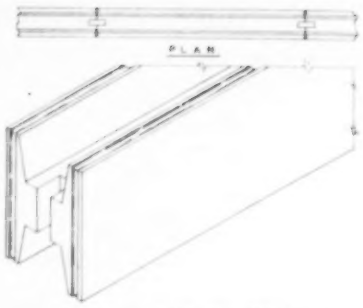


Fig. 3.—Block for Walls.

Longitudinal Reinforcement in Concrete Roads.

A REPORT on the condition of an experimental concrete road to ascertain the value of longitudinal reinforcement has been issued by the Bureau of Public Roads of the U.S. Department of Commerce, and is published in "Public Roads" for February, 1955. The road was built in 1938, and the report deals with its condition 15½ years later. The road is 20 ft. wide and 7 in. thick except at the sides where the thickness is 9 in. The daily traffic averaged nearly 8000 vehicles, of which one in four were lorries and buses.

The road contains sections varying in length from 20 ft. to 1310 ft. Three types of steel were used, and the amount of longitudinal reinforcement varied from 0·07 to 1·82 per cent. The purpose of the research was to obtain information on the possibilities of reducing the number of transverse joints by the use of longitudinal steel reinforcement.

It appears that, with a suitable amount of longitudinal reinforcement, any spacing of transverse joints within the range studied gives satisfactory performance, without failure of the steel or adverse effects on the concrete. In the long sections with much reinforcement numerous closely-spaced transverse cracks have developed, but these have not opened and are not detrimental to the smoothness of the surface or the life of the road. In fact, an outstanding impression is the superficial nature and structurally harmless character of transverse cracks kept closed by continuous longitudinal reinforcement. Irrespective of the length of the section, all cracks kept closed by reinforcement have been highly resistant to "pumping", free of faults, and have required little or no maintenance. Longitudinal reinforcement in very large amounts can be used without danger of cracking of the concrete above the steel, failure due to buckling, or disintegration of the concrete. Longitudinal reinforcement in amounts of 0·11 per cent. or less should be used with caution in roads subjected to heavy vehicles. The performance of the longest sections indicates that continuously reinforced roads will be less susceptible to "pumping" than roads of other designs, although under certain conditions of traffic and subgrade they will not be immune from "pumping" along the free longitudinal edge.

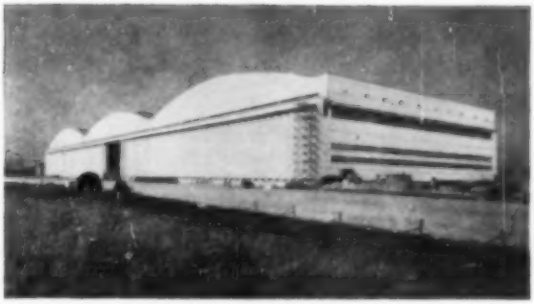
Steel Girder Bridges.

BRITISH STANDARD No. 153, Part 3A, entitled "Girder Bridges", has been issued by the British Standards Association at a price of 6*s*. It gives recommendations for the loads on and permissible stresses in steel girder bridges.

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Retaining Wall at Clydebank.

Two different types of retaining wall have been built along the canal bank at Singers factory at Clydebank.

The first part to be built is 550 yd. long and consists of 18-in. by 8-in. prestressed concrete sheet piles mostly 10 ft. or 12 ft. long and some 20 ft. long. A cross section is shown in *Fig.* 1 and a detail of the expansion joint in *Fig.* 2. The reinforced concrete capping is 1 ft. 8 in. square and secured at intervals of 20 ft. to anchor blocks by 2-in. diameter mild steel tie-rods. It was found that the best

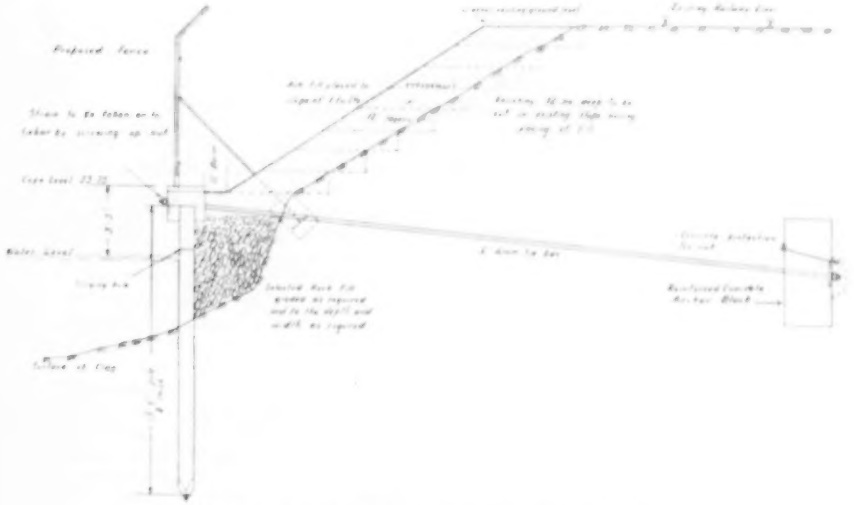


Fig. 1.—Cross Section of First Part of Wall.

results were obtained with a 2½-tons drop-hammer falling 3 ft. The piling frame, boiler, and steam winch were erected on a barge which could be moved along the canal bank as piling proceeded. To prevent the plant from overturning, the barge and the piling frame were always securely tied to the bank.

The second type of wall (*Figs.* 3 to 6) is about 300 yd. long. Its purpose is to protect the bank from erosion and to raise the ground level about 8 ft. to the general ground level of the factory area. The wall provides a width of canal of 60 ft. and will carry a railway track. Due to erosion, the maximum width of the canal was about 80 ft. and the average width 70 ft., so that the wall was mostly constructed in water. The ground varied in different layers from stiff clay to a mixture of sand and gravel covered by a thin topsoil. The depth of water along the face of the wall varies from about 1 ft. to 6 ft. with an average of 3 ft.

The lower part of the wall is formed of prestressed piles which retain only that portion of the ground below the base-slab and a small load from the filling. These piles are 1 ft. 6 in. by 4 in. in cross section along most of the wall and 1 ft. 6 in. by 6 in. where the depth of water is about 7 ft.

Above the sheet piles is an in-situ wall with counterforts each carried on two bearing piles 9 in. square. These piles were driven with a 2-tons hammer suspended from a 19 R.B. pile-driver with false leaders supported on the walings for the piles. A level area was formed along the bank on which to move the machine, and it required only a short time to align the machine for redriving the piles. The piles are from 15 ft. to 20 ft. long; the front pile was designed for a maximum load of 30 tons and the back pile 20 tons.

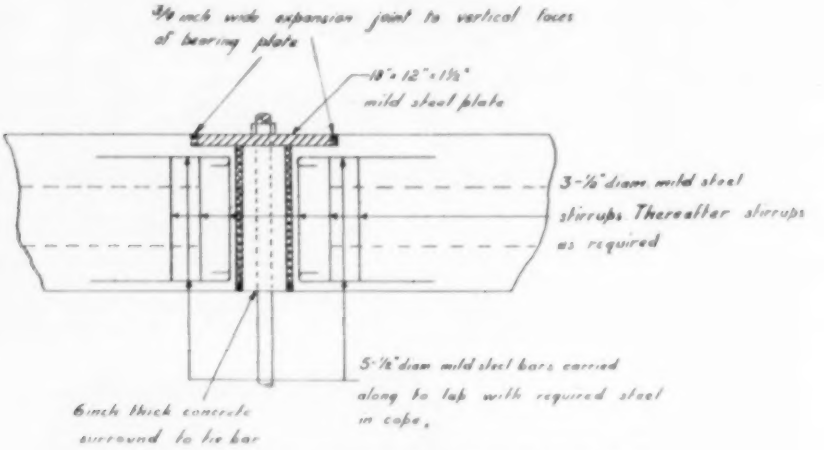


Fig. 2.—Expansion Joint in First Part of Wall.

All the piles were cured in steam after manufacture and in air for at least a further seven days before they were driven. The fall of the hammer was 2 ft., and it was found that increase of fall damaged the pile. A small light helmet to the neat size of the pile was used with about 3 in. of timber packing. In general it was found beneficial to pitch the pile with a slight slope away from the canal bank; after a few blows the pile became vertical, and generally remained so while it was bolted to the leaders. The piles were driven to a final set of 1 in. to ten blows, and the required set generally occurred at a penetration of 9 ft. to 12 ft. The minimum set obtained was $\frac{1}{8}$ in. per blow. Redriving tests were made on many of the piles at periods of one to fifteen days after the initial driving. A slight increase in set was obtained after one day's rest, but after four or five days the set on redriving was the same as when the initial driving stopped. In one soft patch of clay for a length of about 30 yd. no set could be obtained of less than 2 in. per blow; in this part one or two intermediate piles were driven.

The 1-ft. by 4-in. prestressed sheet piles, about 9 ft. long, were driven with a 1½-tons hammer to a depth of up to 3 ft. Further penetration greatly increased the chances of damaging the piles, and the first indication of damage was that the pile split from top to bottom. In general the depth of water was 3 ft., and the piles were designed for a bending moment of 750 ft.-lb.

In part of this wall prestressed sheet piles, 1 ft. 6 in. by 6 in. in cross section by 14 ft. long and designed for a bending moment of 4000 ft.-lb., were driven by the same machine with a 2-tons hammer. The depth of water was in general 4 ft. to 6 ft. and the penetration 5 ft. to 7 ft.; this extra depth was necessary due to the anticipated dredging in the canal, and it was found that 8 ft. was about the maximum penetration to which these piles could be driven in this type of clay.

The sheet piles were driven between walings fixed to the bearing piles. It was found that with reasonable care the



Fig. 3.—Second Part of Wall during Construction.

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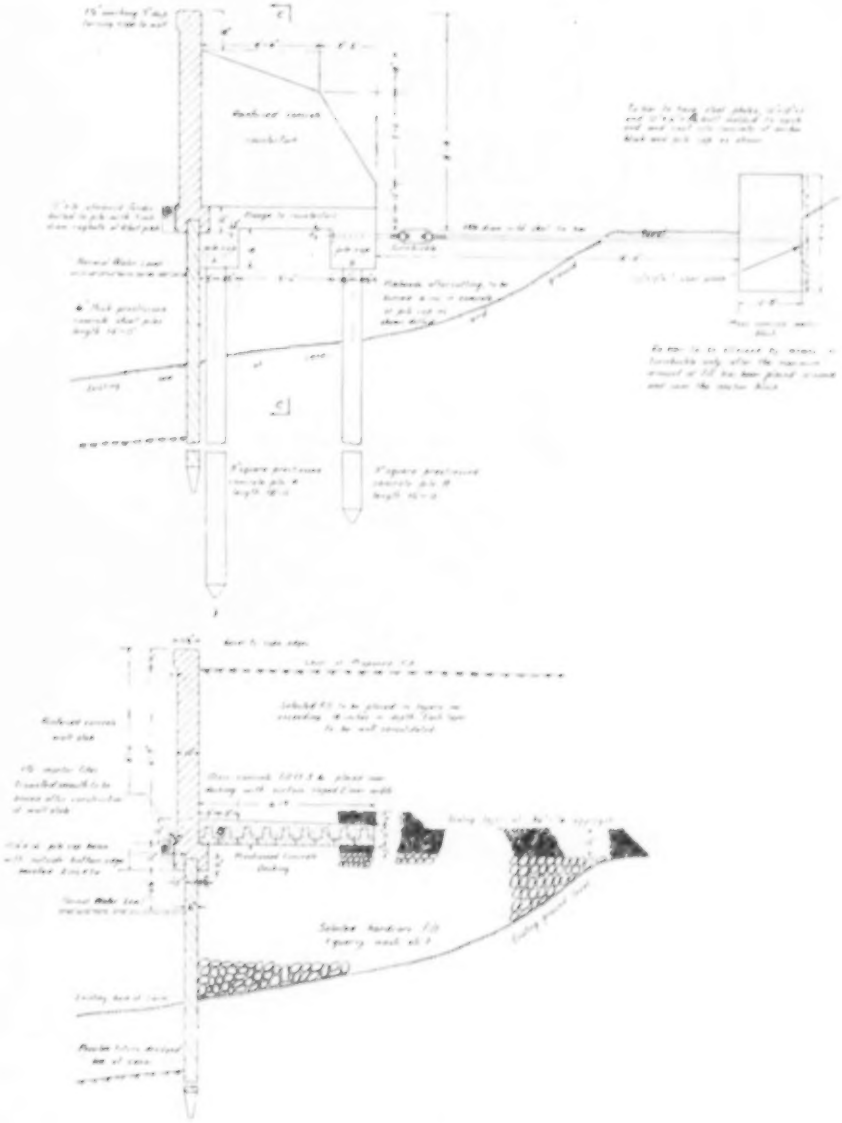


Fig. 4.—Cross Sections through Second Wall.

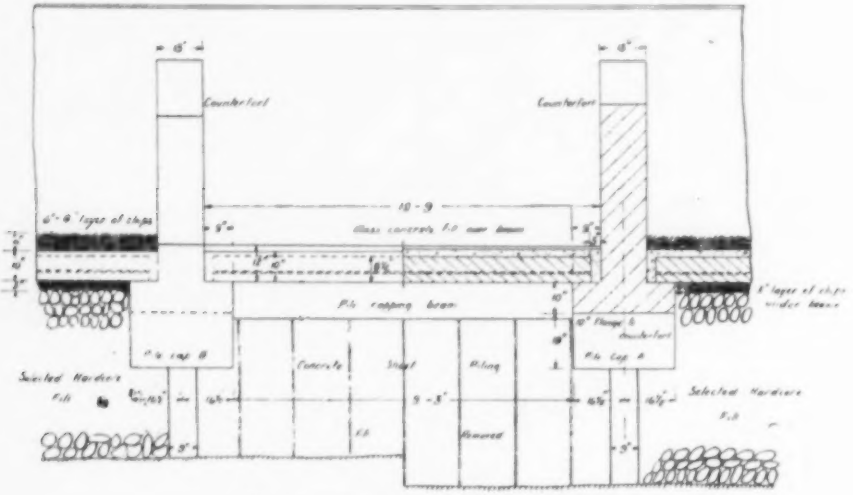


Fig. 5.—Elevation of Second Wall.

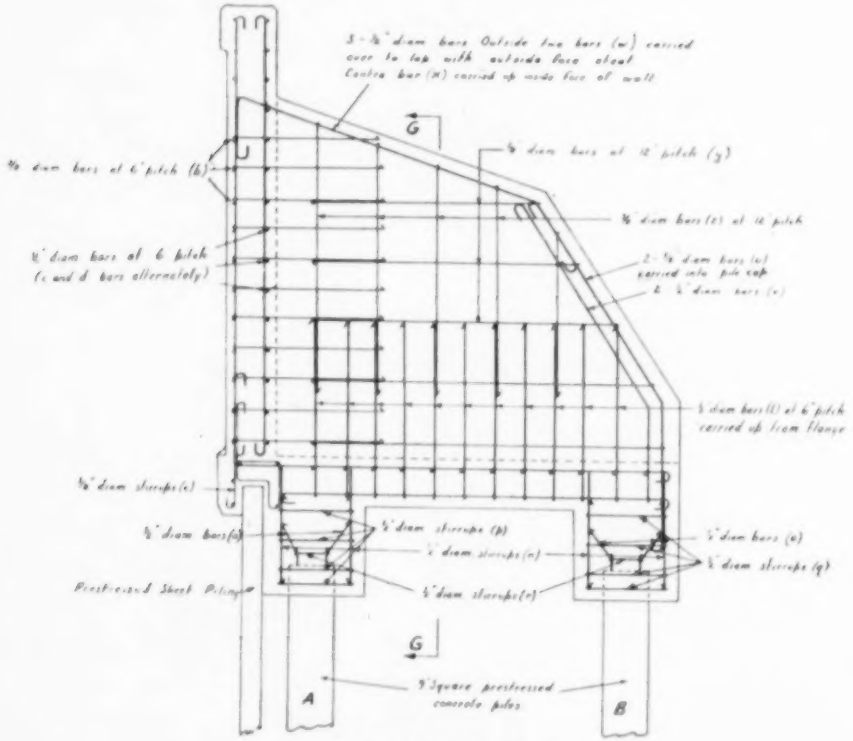
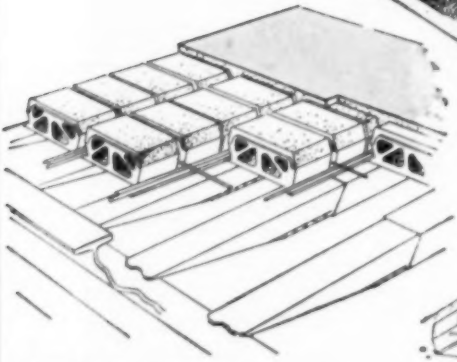


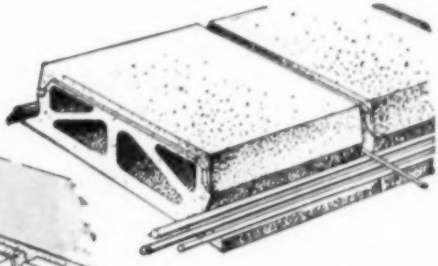
Fig. 6.—Details of Counterfort.

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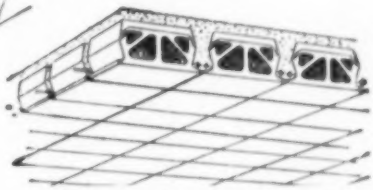
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piles could be driven to the required line with small joints between. The maximum width of joint was limited to ½ in. The piles had a blunt-pointed toe but no shoe. The tops were narrower than the rest of the piles so that, with the helmet on, they could be driven to about the same level. Many of the piles 4 in. thick had to have the tops cut due to the risk of damage if further penetration was tried.

In the first part of the wall the piles had vee-joints about 1½ in. deep. It was found that this joint in the piles 8 in. thick was not effective in keeping the piles in position, and, unless great care was taken in aligning the piles before driving, the joint did not pull the piles into line. In fact when piles were driven slightly out of alignment the outside edges of the groove were invariably broken off. In the second part of the wall the joints were omitted.

After driving the sheet piles, the counterforts and wall were concreted in lengths of about 60 ft. between expansion joints at every fifth counterfort. Consolidation was by immersion vibrators. Next, the prestressed precast concrete deck beams (*Fig.* 4) were placed between the counterforts followed by the plain concrete topping, and two or three weeks after concreting the wall the counterforts at the expansion joints were concreted.

The piles and beams were made, by the pre-tensioning method, by the Costain Concrete Co., Ltd., at Newmains. The 9-in. by 9-in. bearing-piles were prestressed with thirteen 0·2-in. diameter wires and reinforced with ¼-in. diameter stirrups at 2-in. centres in the top and bottom 2 ft. and at 6-in. pitch in the remainder of the length. They also have four ½-in. vertical bars in the top 5 ft.

The 12-in. by 4-in. sheet piles contain twelve 0·2-in. wires with ⅜-in. mild steel stirrups at 3-in. centres for a distance of 1 ft. 6 in. from the top and bottom and at 6-in. centres in the remainder of the pile.

The 1-ft. 6-in. by 6-in. and 1-ft. 6-in. by 8-in. sheet piles contain fifteen 0·2-in. wires with ⅜-in. mild steel stirrups at 3-in. centres for a distance of 2 ft. from top and bottom and at 6-in. centres in the remainder.

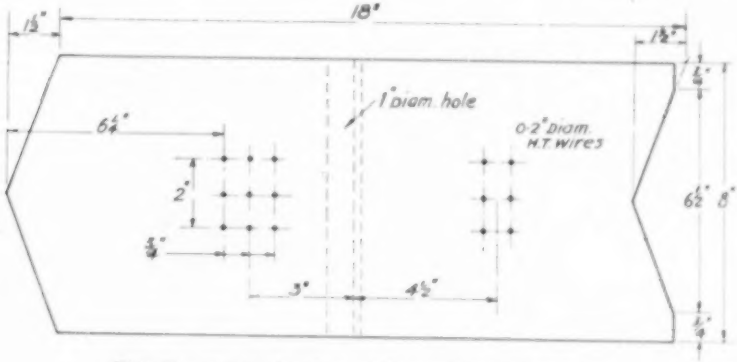


Fig. 7.—Cross Section of Prestressed Sheet Pile.

The concrete had a minimum compressive strength of 6800 lb. per square inch at seven days. The prestressing wires had an ultimate tensile strength of 120 to 150 tons per square inch. The wires were tensioned to 70 tons per square inch. A detail of a 1 ft. 6 in. by 8 in. sheet pile 13 ft. 6 in. long is given in *Fig.* 7.

The consulting engineers are Messrs. Cowan & Linn, of Glasgow. Messrs. McKean & Co., Ltd., of Glasgow, were the contractors for the first part of the wall, and Messrs. Hugh Leggatt, Ltd., of Glasgow, for the second part. The foregoing is abstracted from a paper, by Mr. Basil A. M. Watt, which was awarded a Millar Prize by the Institution of Civil Engineers.

International Congress on Prestressed Concrete.

THE syllabus is now available of the second International Congress on Prestressed Concrete to be held by the Fédération Internationale de la Précontrainte at Amsterdam from August 29 to September 2. The subjects to be discussed are (1) The effect of grouting and anchorage of prestressing steel, (2) the manufacture and use of steel for prestressing, (3) progress in prestressed precast members made in a factory and assembled on the site, (4) moment-distribution in statically-indeterminate structures beyond the elastic stage, (5) the influence of plasticity on the strength and stability of thin shells, (6) comparison of specifications and practice in different countries, and (7) economical advantages of prestressed concrete in various countries.

Full particulars of the congress may be had from Ir. J. A. H. Hartmann, Groningsstraat 15, Den Haag, Holland, or from the Prestressed Concrete Development Group of the Cement and Concrete Association, 52 Grosvenor Gardens, London, S.W.1.

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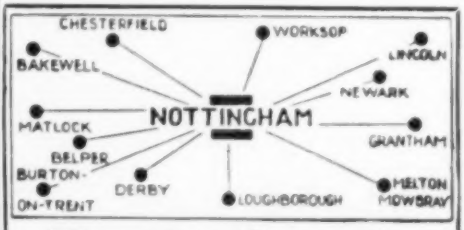
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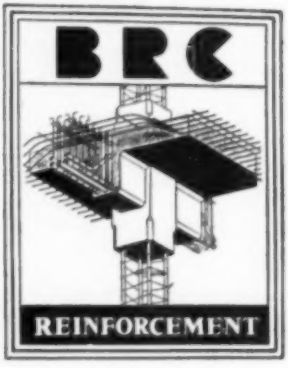
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Situations Wanted, 3d. a word: minimum, 7s. 6d. Situations Vacant, 4d. a word: minimum, 10s. Other miscellaneous advertisements, 4d. a word: 10s. minimum. Displayed advertisements, 30s. per column inch. Box number 1s. extra. The engagement of persons answering these advertisements is subject to the Notification of Vacancies Order, 1952.

Advertisements must reach this office by the 23rd of the month preceding publication.

SITUATIONS VACANT.

SITUATION VACANT. Concrete formwork designer-draughtsman required by civil engineering contractors in Westminster. Apply in writing only, stating age, experience, and salary required, to PETER LIND & CO., LTD., Romney House, Tufton Street, London, S.W.1.

SITUATIONS VACANT. Experienced reinforced concrete designers and detailers required by consulting engineers in their Sunbury office. Five-days' week. Permanent position, good salary and prospects. Apply, stating age and experience, to J. H. COOMBS & PARTNERS, Thames Corner, Sunbury-on-Thames.

SITUATION VACANT. Reinforced concrete detailer required for consulting engineer's office. Good experience in reinforced concrete essential. Five-days' week. Apply in writing, giving details of experience and salary required, to F. J. SAMUELY, 8 Hamilton Place, London, W.1.

SITUATIONS VACANT. THE TRUSSED CONCRETE STEEL CO., LTD., have vacancies in their London, Birmingham, Glasgow, and Manchester offices for reinforced concrete designers and detailers. Five-days' week. Pension scheme. Apply, giving full particulars of age, education, and previous experience, to the SECRETARY, Truscon House, 35-41 Lower Marsh, London, S.E.1.

SITUATIONS VACANT. Reinforced concrete designers and detailers required by consulting engineers to work in Surrey office. Good working conditions and five-days' week. Salaries £500-£900 per annum, according to experience and ability. Permanent positions with excellent prospects. Apply, giving full details, to BOX 4138, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATIONS VACANT. Reinforced concrete designer-draughtsmen required by ASHMORE, BENSON, PEASE & CO., Stockton-on-Tees. Applicants should be fully experienced in either designing or detailing reinforced concrete structures, foundations and other civil work. Maximum assistance given in obtaining accommodation, pension scheme, technical library, and sports facilities available. Apply, stating age, experience, etc., quoting reference "D", to STAFF PERSONNEL OFFICER.

SITUATIONS VACANT. A large firm of reinforced concrete engineers in Rhodesia and the Union of South Africa has vacancies for reinforced concrete designers and detailers with experience. Apply in writing, with full details of qualifications and experience, age, and salary required, to BOX R4/4/55, 95 Bishopsgate, London, E.C.2.

SITUATION VACANT. Applied building research. Substantial building organisation requires a chief research assistant with forward outlook, for development of new materials and techniques and supervision of concrete and prestressed concrete quality controls. Suitable qualifications and experience required. Five-days' week and pension scheme. Headquarters near London. Apply, stating salary expected, to BOX 4145, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATIONS VACANT. Reinforced concrete designer-detailers wanted by British Co. in Mombasa (Kenya), Kampala (Uganda), and Dar-es-Salaam (Tanganyika). Candidates should have had at least five years' experience. Salary according to ability and experience. Free air passages, two months' paid home leave by air each 2½ years, bonus and pension schemes. Applications will be treated in strict confidence. Write BOX R13/4/55, 95 Bishopsgate, London, E.C.2.

GLAMORGAN COUNTY COUNCIL.

Applications are invited for the temporary appointment of a RESIDENT ENGINEER for a period of approximately two years to supervise the erection of a Seven-Form-Entry COMPREHENSIVE SECONDARY SCHOOL, to be constructed mainly of reinforced concrete, at SANDFIELDS, PORT TALBOT.

Applicants must have had considerable experience in the supervision and construction of reinforced concrete structures, should be well acquainted with the quality control of concrete, and must have a sound knowledge of good general building construction. Preference will be accorded to applicants who are Chartered Civil or Structural Engineers.

Salary £1,100 per annum plus a weekly lodging allowance of £3 0. 0. or reasonable travelling expenses (but not both).

Applications, giving age qualifications, training and experience, together with details of at least two references, should be forwarded to E. A. E. EVANS, A.R.I.B.A., County Architect, County Hall, Cardiff, not later than fourteen days after appearance of this advertisement.

RICHARD JOHN
Clerk of the County Council.

SITUATIONS VACANT. Technical representatives required. Applications are invited from persons (residing in the Cheshire/Lancashire area) possessing a first-class knowledge of concrete products, especially patented concrete floor beams. Pension scheme. Replies, giving details of age, experience, sales record, and salary, to PERSONNEL MANAGER, KINGSTON CONCRETE PRODUCTS, LTD., Ryde Avenue, Hull.

SITUATIONS VACANT. TWISTEEL REINFORCEMENT, LTD., have vacancies for designers and detailers in their London, Birmingham, and Manchester drawing offices. Apply, stating experience, to 43 Upper Grosvenor Street, London, W.1.

SITUATION VACANT. Designer-draughtsman required for London head office of a firm of reinforced concrete engineers and contractors. Applicants should be qualified and possess experience of building frame design and knowledge of precast and prestressed concrete construction. The post is permanent and pensionable. Two weeks' holiday allowed this year. Salary according to qualifications and experience. Write full particulars to BOX 4157, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATIONS VACANT. Consulting structural engineers require assistants with at least two years' office experience in designing and/or detailing steel and reinforced concrete frameworks and foundations, following graduateship and National Service. Salary £500 to £700 per annum, according to age, experience, and qualifications. Apply ANDREWS, KENT & STONE, 60 Wardour Street, London, W.1. Gerrard 9341.

SITUATION VACANT. Senior designer-detailer (reinforced concrete) required by the Rhodesian Engineering and Steel Construction Co., Ltd., Bulawayo, Southern Rhodesia. Applicants should have had minimum of ten years' drawing office experience, able to work without supervision, and be familiar with all phases of reinforced concrete design and details, and be able to prepare estimated quantities of reinforcing steel from architects' drawings. Commencing salary £1,500 per annum. Provident fund, and medical aid scheme. Company will pay successful applicant air or sea fare and expenses, also £100 towards fare for wife, family, and effects. Reply, giving full details of experience, to Box P94, JACKSON'S, 54 Old Broad Street, London, E.C.2.

SITUATIONS VACANT. CLARKE, NICHOLLS & MARCEL, Consulting Engineers, require for their Bristol office engineers with a wide experience of reinforced concrete work. Interesting work and good prospects. Reply, giving details of experience and salary required, to Berkeley Cottage, Berkeley Square, Bristol, 8.

SITUATIONS VACANT. Reinforced concrete engineers require detailers and junior draughtsmen. Write, giving age, experience, and salary required, to CONSIDERE CONSTRUCTIONS, LTD., 72 Victoria Street, Westminster, S.W.1.

(Continued on next page.)

(*Continued from previous page.*)

SITUATIONS VACANT. Reinforced concrete designers (senior and junior) required by consulting engineers for varied and interesting building frames and industrial structures. Good prospects. Five-days' week. Lunch vouchers. Apply, with details of experience, etc., to JOHN F. FARQUHARSON & PARTNERS, Chartered Structural Engineers, 34 Queen Anne Street, London, W.1. LANgham 6081.

SITUATION VACANT. Sales representative required by manufacturers of reconstructed stone and precast concrete floors, to cover Lincolnshire, East Anglia and East Midlands. Previous experience and/or good architectural connections an advantage. Box 4158, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATION VACANT. General works manager required to take complete works control, subject to director. Man experienced in concrete tile and pipe mass production methods. Factory in Ireland, near Dublin. Salary depending on experience and ability, but not less than £1,c00 per annum. Box 4159, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

JOHN LIVERSEDGE & ASSOCIATES, CONSULTING STRUCTURAL ENGINEERS, invite immediate applications for the following additional drawing-office staff.

(*a*) Designer-detailers (3), minimum 3 years' experience, for reinforced concrete work of varied types. Structural steelwork experience an advantage;

(*b*) Detailer-draughtsmen (6), with experience in reinforced concrete detailing, preferably H.N.C. standard;

(*c*) Junior draughtsmen and juniors for training (6).

Modern office conditions, 5-days' week, good pay according to ability, with opportunity for advancement.

Applications to 42 Portland Place, London, W.1.

SITUATIONS VACANT. The British Reinforced Concrete Engineering Co., Ltd., have vacancies for reinforced concrete designers and detailers, with experience, in their Stafford, London, Liverpool, Bristol, Newcastle on Tyne, and Glasgow offices. Staff pension scheme and five-days' week. Apply in writing to CHIEF ENGINEER, Stafford.

SITUATION VACANT. Young and energetic structural engineer required for supervision of development work in prestressed concrete construction. Salary £450 to £600, depending on experience. Apply, giving details of qualification, to UDALLS PRESTRESSED CONCRETE, LTD., West Quay Road, Southampton.

SITUATION VACANT. Consulting engineer requires structural assistant experienced in reinforced and prestressed concrete design. Salary from £650 to £800, depending on experience. Write, giving details of qualifications, to E. W. H. GIFFORD, 8 Rockstone Place, Southampton.

SITUATIONS VACANT. Monsanto Chemicals, Ltd., require senior civil engineering draughtsmen for their London design office. Applicants should be capable of designing either reinforced concrete, piled foundations, or structural steelwork. Some experience in building details would be an advantage. Salaries offered will be commensurate with qualifications and experience. Apply in writing, giving full details of age, education, training, and experience, to the CHIEF PERSONNEL OFFICER, MONSANTO CHEMICALS, LTD., 8 Waterloo Place, London, S.W.1.

SITUATION VACANT. Firm of reinforced concrete engineers require a technically trained representative to function as assistant to their divisional engineer operating from their York office. Write, stating age, experience, and present salary, to Box C.E.345, 191 Gresham House, London, E.C.2.

LONDON COUNTY COUNCIL.
Architect's Department.

Vacancies in the Structural Engineering Division for Resident Engineers (salary up to £892 10s.). Candidates should have B.Sc., A.M.I.C.E., or A.M.I.Struct.E., preferably with experience in supervision of reinforced concrete and/or steel-framed structures on the site, although those with adequate knowledge and experience of design alone will also be considered. Application forms, returnable by 20th June, from ARCHITECT (AR/EK/RE/4), The County Hall, London, S.E.1. (642)

SITUATIONS VACANT. Consulting Engineers have vacancies for senior and junior qualified engineering assistants in Kenya with experience in the design of reinforced concrete and steelwork structures, with site supervision (a knowledge of surveying will be an advantage). Varied projects with scope for initiative and opportunities for advancement. Candidates should be single, and between the ages of 24 and 32. Salary, leave facilities and other terms of appointment in accordance with experience. Air passages for applicants from abroad will be paid. Applications, which should be made in writing, giving full particulars of age, education, qualifications, and experience, with some recent references, should be addressed to PETER M. AMCOTTS & PARTNERS, P.O. Box 8505, Nairobi, Kenya.

SITUATIONS VACANT. Reinforced concrete design engineers required in the drawing office by civil engineering contractors specialising in foundations. Excellent prospects, salary, bonus and pension scheme. Applications in writing to WEST'S PILING & CONSTRUCTION CO. LTD., Bath Road, Harmondsworth, West Drayton, Middx.

SITUATIONS VACANT. Detailer-draughtsmen wishing to gain experience of reinforced concrete coal bunkers and other interesting industrial structures are requested to write, stating age, experience, and salary required, to J. C. HUGHES & PARTNERS, 83 Gloucester Place, London, W.1.

SITUATION VACANT. Consulting engineers in Birmingham require reinforced concrete engineer, preferably with experience of estimating, design, and project work. Apply in strict confidence, stating age, training, experience, and salary required, to Box 4161, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATION VACANT. Design assistant required for company manufacturing prestressed concrete. Variety of design in prestressed and reinforced concrete. Applicant should be familiar with the normal methods of structural analysis. Apply, giving full details and salary required, Box 4162, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATIONS VACANT. Reinforced concrete designers and detailers required. Permanent position with good prospects. Pension scheme, five days' week, and luncheon vouchers. Write or telephone for interview. E. J. COOK & CO. (ENGINEERS), LTD., 54 South Side Clapham Common, London, S.W.4. MACaulay 5522.

SITUATIONS VACANT. Draughtsmen-detailers required for London office of consulting engineers. Some drawing-office experience in reinforced concrete work essential. Five days' week, pension scheme, luncheon club. Apply in writing with full particulars of age, experience, and salary required, to Box 8744, CHARLES BARKER & SONS, LTD., 31 Budge Row, London, E.C.4.

SITUATIONS VACANT. R. TRAVERS MORGAN & PARTNERS, consulting engineers, have vacancies for experienced engineers and designer-detailers in reinforced concrete and steelwork. Wide variety of work at home and abroad. Experience in bridge design an advantage. Apply in writing giving details of experience, etc., to 11 Victoria Street, London, S.W.1.

SITUATIONS VACANT. Consulting engineer, Westminster, requires reinforced concrete designer-draughtsmen. Also required, designers with experience in shell roofs. Apply giving full particulars, to JAMES E. WARDROPPER, 116 Victoria Street, London, S.W.1.

(*Continued on next page.*)

MISCELLANEOUS ADVERTISEMENTS.

(Continued from previous page.)

SITUATIONS VACANT. Reinforced concrete designer-draughtsmen required by engineers and contractors for their London office. Salaries up to the range of £800 to £850 per annum are envisaged for the right applicants who should have had several years' experience in the design and detailing of reinforced concrete frames and/or floors, and should be quick, neat, and accurate draughtsmen. Working conditions are good, and there is a non-contributory pension scheme. Two weeks' holiday this year. Present staff notified of this advertisement. Applicants should reply, giving full details of their age and career, to BOX 4164, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

SITUATIONS VACANT. Leading structural engineering assistants are required by the UNITED KINGDOM ATOMIC ENERGY AUTHORITY at Risley, nr. Warrington (Ref. 954) and at Dounreay, Caithness, Scotland (Ref. 955), for the preparation of calculations and detail drawings for all types of structures in steel and/or concrete under the supervision of a senior structural engineering assistant. Applicants should possess a H.N.C. in structural or civil engineering. Salary £710–£830 p.a. The successful candidates will be required to join the Authority's contributory pension scheme. Send postcard for application form to the UNITED KINGDOM ATOMIC ENERGY AUTHORITY, Industrial Group Headquarters, Risley, nr. Warrington. The appropriate reference must be quoted.

SITUATIONS VACANT. Assistant structural engineers are required by the UNITED KINGDOM ATOMIC ENERGY AUTHORITY, at Risley, nr. Warrington (Ref. 957) and Calder Works, nr. Sellafield, Cumberland (Ref. 958), to be responsible under the supervision of a structural engineer for all design calculations carried out by a design office section, for the general direction of such a section, and for ensuring that the basic design is correctly interpreted in the detail drawings. Applicants should have had not less than two years' design office experience and should be Corporate Members of the Institution of Structural or Civil Engineers, or have equivalent qualifications. Some site experience may be desirable. Salary £695 (at age 25)–£1,065 p.a. The successful candidates will be required to join the Authority's contributory pension scheme. Send postcard for application form to the UNITED KINGDOM ATOMIC ENERGY AUTHORITY, Industrial Group Headquarters, Risley, nr. Warrington. The appropriate reference must be quoted.

SITUATIONS VACANT. Senior structural engineering assistants (supervisors/designers) are required by the UNITED KINGDOM ATOMIC ENERGY AUTHORITY, at Risley, nr. Warrington. Supervisors are responsible for the control of a design office section engaged on the preparation of calculations and detail drawings for all types of structures and should have not less than ten years' experience in a design office and a good knowledge of the design and detail of all normal structures, both in reinforced concrete and structural steelwork. Designers are responsible for the preparation of calculations and scheme drawings for the more advanced types of structure and should have a fair knowledge of design in reinforced concrete and structural steelwork, with a specialised knowledge of one, and possess a H.N.C. in structural or civil engineering or equivalent qualifications. Salary £830–£1,015 p.a. The successful candidates will be required to join the Authority's contributory pension scheme. Send postcard for application form to the UNITED KINGDOM ATOMIC ENERGY AUTHORITY, Industrial Group Headquarters, Risley, nr. Warrington. Reference 956 must be quoted.

SITUATION WANTED.

SITUATION WANTED. Young man just leaving school, with grammar school education and desirous of learning all aspects of the concrete industry in accordance with the syllabus of the B.C.C.F. and C.S. and C.F., wishes to obtain appointment commencing after July, 1955. The young man is of personable appearance, hard working and keen to learn, and would be pleased to hear of any opportunity available. BOX 4163, CONCRETE AND CONSTRUCTIONAL ENGINEERING, 14 Dartmouth Street, London, S.W.1.

FOR HIRE.

FOR HIRE. Lattice steel erection masts (light and heavy), 30 ft. to 150 ft. high, for immediate hire. BELLMAN'S, 21 Hobart House, Grosvenor Place, London, S.W.1.

DRAUGHTSMEN.
SIMON-CARVES LTD.

have vacancies in their

MAYFAIR DRAWING OFFICE

for draughtsmen with sound experience of reinforced concrete industrial structures. Working conditions and scope are good. 5-days' week. Starting salaries will depend on experience and qualifications; for senior men they will range up to £850 a year. A Pension Fund and a non-contributory sickness benefit scheme are in operation. Interviews will take place in London. Write, quoting ref. D.S.54, to Staff & Training Division, Simon-Carves Ltd., Cheadle Heath, Stockport.

PORT OF LONDON AUTHORITY.

The PORT OF LONDON AUTHORITY invite applications for the position of Assistant Engineer (Civil) at a salary (inclusive of Pay Supplement) of £995, rising by annual increments to £1,356 per annum.

Candidates, who must be British subjects and Corporate Members of the Institution of Civil Engineers, should have experience in the planning, design, and specification of Dock and Harbour civil engineering works, and of their construction and maintenance. Preference will be given to candidates not over 40 years of age.

Successful applicants will be required to become members of the Port of London Authority's contributory superannuation scheme. In certain cases existing pensionable service is transferable.

Application forms may be obtained from the Establishment Officer, Port of London Authority, Trinity Square, London, E.C.3.

E. S. BIRCH
Secretary.

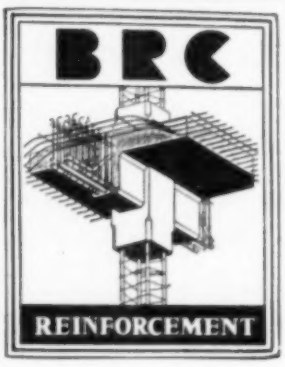
LONDON COUNTY COUNCIL.
Architect's Department.

STRUCTURAL ENGINEER, Grade I (£1,071 to £1,224), required to investigate new structural techniques and experimental methods with special regard to multi-storey buildings.

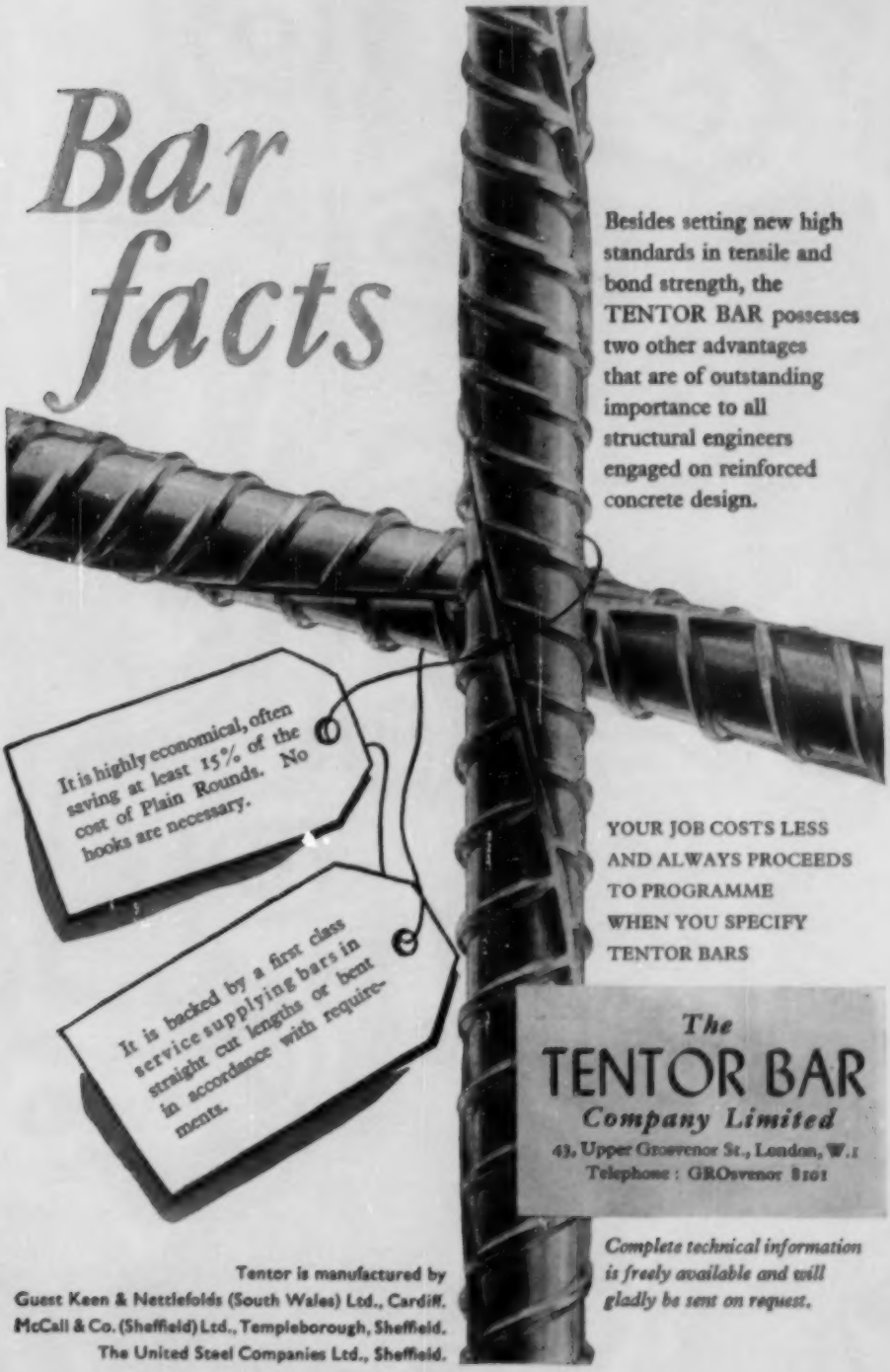
Application form, returnable by 20th June, 1955, from Architect (AR/EK/SE/6), The County Hall, London, S.E.1. (691)

FOR SALE, PATENT & AUCTION

advertisements are on page 246.



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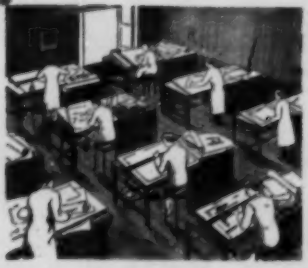
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